

# A revision of the Lake Victoria *Haplochromis* species (Pisces, Cichlidae), Part VIII

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## Introduction

Seven of the eight species described in this paper were collected during June 1975 by Drs G. Ch. Anker and C. D. N. Barel in the Mwanza and Speke Gulf regions (Tanzania) of Lake Victoria. The material was taken from trawl catches made, in general, over mud substrata and, for the most part, at depths of 2–10 m; one station, however, was considerably deeper (28 m); see Fig. 1. The eighth species is from much deeper water (50–60 m) in the northern (Ugandan) part of the Lake; it was collected by the senior author in 1970 during a survey cruise in the R.V. *Ibis*, then based at Jinja as part of a joint U.N.D.P.–E.A.F.F.R.O. research project into the fishery potential of Lake Victoria. All eight taxa must be considered elements of the still largely unknown offshore complex of *Haplochromis* species, now, or soon to be tapped by the developing trawl fishery on the lake.

On the basis of data from collections made in various parts of Lake Victoria, it seems likely that the Mwanza and Speke Gulf species are confined to relatively shallow and sublittoral habitats, while the Ugandan species is restricted to deeper waters. It may be of some significance that none of the new Tanzanian species has been recorded from other and similar biotopes in the lake, yet they were captured together with several species known to have a lake-wide distribution in such habitats.

The new species are of particular interest because they include three new members of the *H. tridens* species complex, two additions to the *H. ishmaeli*-*H. pharyngomylus* grade of mollusc crushers, a new member of the *H. empodisma*-*H. obtusidens* mollusc-insectivore lineage, and the first 'dwarf' member of the *H. serranus* lineage, a group of piscivorous species whose members otherwise reach some of the larger adult sizes found among the Lake Victoria species. (For

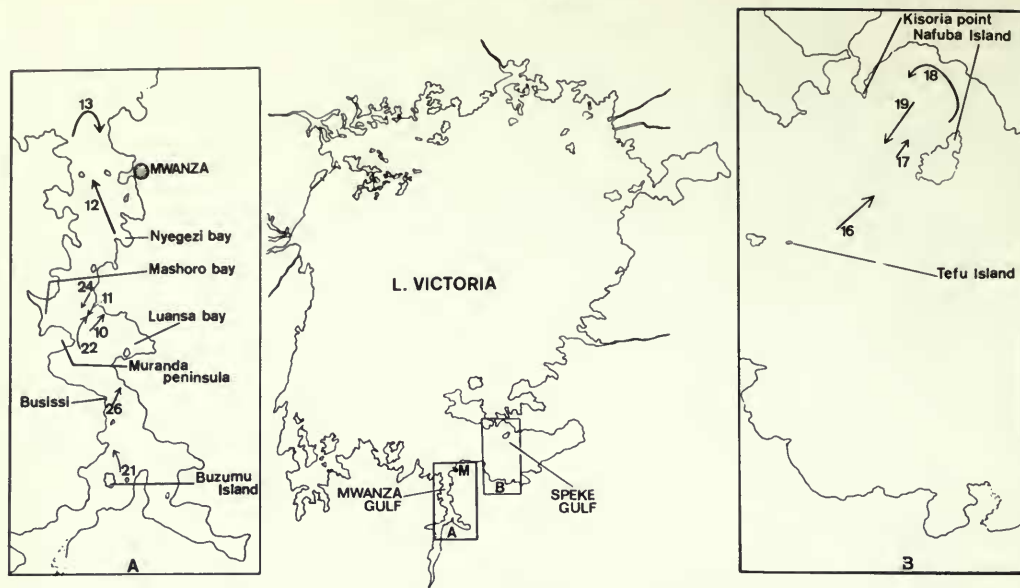


Fig. 1 Sketch map of Lake Victoria with (A) the Mwanza Gulf, and (B) the Speke Gulf, drawn to a larger scale. The numbers refer to Anker-Barel collecting stations, and the arrows to the direction in which the trawl shot at that station was fished.

details of these various groups and their presumed phyletic relationships, see Greenwood, 1974.) The eighth new taxon, also apparently a member of the *H. serranus* lineage, has a most distinctive oral and dental morphology strongly suggestive of fish-eating or other predatory habits, yet it seems to feed, at least in part, on diatoms (see p. 163).

The Anker-Barel collection has also provided a most interesting puzzle in the form of several specimens which appear to bridge the anatomical 'gap' separating the insectivorous-detritus eating *H. empodisma* from its sister species, the insectivorous-molluscivorous *H. obtusidens* (see Greenwood, 1960 & 1974). There are, however, indications that this anatomically intermediate material represents a third taxon in the lineage. Since further observations and material are needed to resolve this problem it, and the new material, will be considered in a later paper.

Drs Barel and Anker were able to gather a lot of useful information on the live coloration of various *Haplochromis* species collected during their visit to the southern end of the lake. An extensive collection of colour transparencies, together with the specimens photographed, has been deposited in the British Museum (Natural History). Many species described or redescribed in previous parts of this revision, and for which no information of live coloration was then available, are represented in the Anker-Barel photographic collection. Colour descriptions of these fishes have been prepared by Mr Martien van Oijen, a postgraduate student in the Zoology Department of Leiden University, and are published as an appendix to this paper.

The eight new taxa will be described in groups based on their presumed phyletic affinities (see Greenwood, 1974), starting with the three new members of the '*tridens*' lineage.

### New species of the *H. tridens* group

#### *Haplochromis crocopeplus* sp. nov.

**HOLOTYPE.** An adult male, 84.0 mm standard length, from the Speke Gulf, between Nafuba and Tefu Islands at a depth of 28 m. BM(NH) reg. no. 1977.1.10:70.

The trivial name (from the Greek) refers to the basically ochrous-yellow coloration of live fishes.

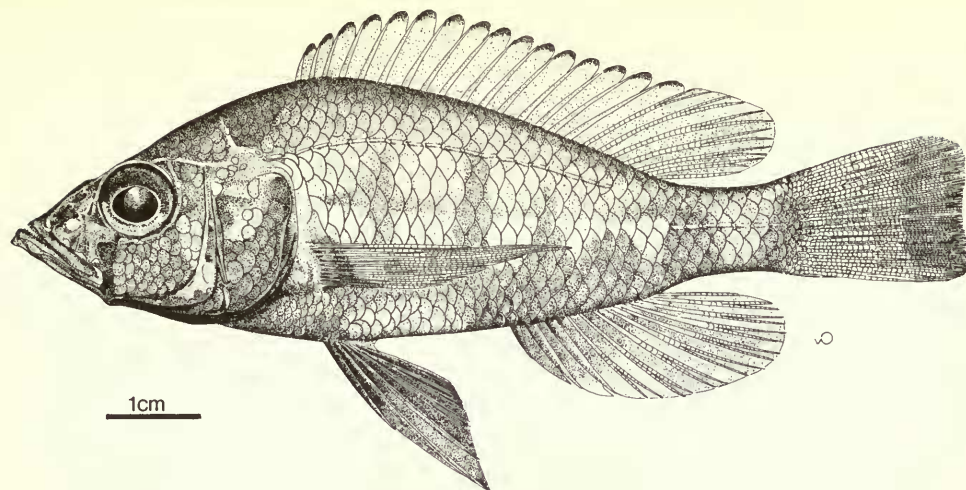


Fig. 2 *Haplochromis crocopeplus*. Holotype. Drawn by M. J. P. van Oijen.

DESCRIPTION (Figs 2–7). Based on 20 specimens (including the holotype), 71.0–100.5 mm standard length.

Depth of body 29.0–35.0% of standard length (mean,  $M=33.0\%$ ), length of head 34.0–38.0 ( $M=36.0\%$ ).

Dorsal head profile straight, sloping at an angle of 30–35°; cephalic lateral line pores prominent, especially the pores and tubules on the preorbital bone.

Preorbital depth 15.0–19.0 ( $M=17.0\%$ ) of head length, least interorbital width 18.0–22.0 ( $M=19.5\%$ ). Snout as broad as it is long, to slightly longer than broad (1.1 times); its length 29.0–31.0 ( $M=30.0\%$ ) of head. Eye and orbit slightly elliptical (i.e. longer than deep), the eye with a narrow anteroventral aphakic aperture; greatest eye diameter 28.0–33.0 ( $M=30.0\%$ ) of head. Cheek depth 17.0–25.0 ( $M=21.0\%$ ).

Caudal peduncle 16.0–20.0 ( $M=18.0\%$ ) of standard length, 1.4–1.8 (modal range 1.5–1.6) times longer than deep.

Mouth inclined at an angle of 30–35° (rarely at 15–20°); posterior tip of the maxilla reaching a vertical slightly behind the anterior margin of the orbit or, less frequently, to a vertical through the anterior margin. The dentigerous arm of the premaxilla is somewhat expanded anteriorly in the midline, giving the bone a weakly beaked appearance; the dentary has a variously developed but obvious mental protuberance. Length of lower jaw 41.0–50.0 ( $M=47.0\%$ ) of head length, 1.7–2.4 (modal range 2.2–2.3) times its width; jaws equal anteriorly.

*Gill rakers.* 9–11 (rarely 8) on the lower part of the first gill arch, the lower 1–4 rakers reduced, the next 3 or 4 generally slender, the uppermost rakers flattened and often bifid or anvil-shaped.

*Scales.* Ctenoid; lateral line with 31 (f.2), 32 (f.6), 33 (f.8) or 34 (f.1) scales in the 17 specimens with undamaged squamation, cheek with 3 or 4 rows. Five and a half to 6½ (rarely 5) scales between the lateral line and the dorsal fin origin, 5½ to 6½ (mode 6), rarely 7, between the pectoral and pelvic fins bases.

*Fins.* Dorsal with 23 (f.4), 24 (f.11) or 25 (f.5) rays, comprising 14 (f.1), 15 (f.14) or 16 (f.5) spines and 7 (f.1), 8 (f.2), 9 (f.16) or 10 (f.1) branched rays. Anal with 11 (f.8), 12 (f.11) or 13 (f.1) rays, comprising 3 spinous and 8 (f.8), 9 (f.10) or 10 (f.2) branched elements. Pectoral fin 26.0–33.0 ( $M=30.0\%$ ) of standard length. Pelvic fins with the first branched ray produced in both sexes. Caudal truncate, scaled on its proximal third to half.

*Teeth.* In both jaws the *outer teeth* have relatively slender, near-cylindrical necks and somewhat compressed, gently recurved crowns. Three different types of crown form are present, viz. unicuspid, unequally bicuspid (sometimes weakly so) and tricuspid. It is difficult to detect any clear-cut spatially correlated arrangement of the different crown types within the outer series,



or to show a definite preponderance of one type over the other. With few exceptions an admixture of all three types is present, usually with the tricuspid restricted to the posterior and posterolateral parts of the row in both jaws, and the bi- and unicuspid occurring anteriorly and anterolaterally. Not infrequently, unicuspid are found only in the upper jaw, and in 6 specimens no unicuspid are present in either jaw. Very rarely do tricuspid teeth predominate in an admixture of cusp types.

There are 70–80 ( $M=74$ ) teeth in the outer row of the upper jaw.

Teeth in the *inner series* are all small and tricuspid, implanted obliquely and arranged in 2 (rarely 1) rows in the upper jaw, and 1 or 2 (rarely 3) in the lower jaw.

*Osteology.* The *neurocranium* of *Haplochromis crocopeplus* (Fig. 3) closely resembles that found in other members of the *Haplochromis tridens* group (see Greenwood & Gee, 1969; Greenwood, 1974), although the supraoccipital crest is, relatively, a little higher, and the preorbital (i.e. ethmovomerine) region somewhat shorter in this species. In these features, the neurocranium of *H. crocopeplus* should be looked upon as representing a less specialized state than that seen in the neurocrania of the other species (see Greenwood, 1974; and below).

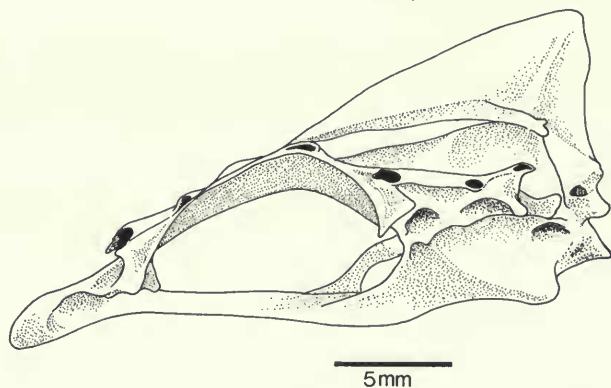


Fig. 3 *Haplochromis crocopeplus*. Neurocranium in left lateral view.

Each ramus of the *dentary* (Fig. 4) has a marked outwardly directed flare to its upper half, thus giving the lateral aspect of the bone a distinctly concave appearance (a feature best seen when the bone is viewed from the front). The concavity extends anteriorly almost to the symphysis.

The *premaxilla* has a moderately developed beak consequent upon the anterior and anterolateral expansion of its medial dentigerous surface; the pedicels (anterior ascending processes) are as long as the dentigerous arms of the bone.

The *lower pharyngeal bone* (Fig. 5) is narrow and slender, its dentigerous surface as broad as it is long (or slightly broader than long). The lower pharyngeal teeth are fine, compressed and cuspidate, and are arranged in 28–32 rows.

There are 28 (f.1), 29 (f.5), 30 (f.10) or 31 (f.1) *vertebrae* (excluding the fused  $PU_1$  and  $U_1$  centra) in the 17 specimens radiographed, the total comprising 12 (f.1), 13 (f.15) or 14 (f.1) abdominal and 15 (f.1), 16 (f.4) or 17 (f.12) caudal centra.

*Coloration.* In life a *sexually mature female* (BM(NH) reg. no. 1977.1.28:39; see Fig. 6) has the dorsum of the body and caudal peduncle grey with a yellow flush, that of the body becoming greyish-silver in the nape region. The flanks and ventral part of the caudal peduncle are ochrous becoming whitish on the belly. Traces of a very faint midlateral stripe are visible on the flanks. The dorsal surface of the head is yellowish-grey, the operculum ochrous yellow, the suboperculum somewhat silvery, the preorbital region and cheeks greyish-ochre (the latter becoming lighter ventrally) and the lips bright ochre. The branchiostegal membrane is yellowish-grey.

The dorsal fin is ochrous, with traces of red proximally, and hyaline spots distally on the soft part of the fin. The caudal is greyish-ochre proximally, yellowish distally; the anal fin is yellow with a grey margin, the pelvics are yellow, and the pectorals yellowish-hyaline.



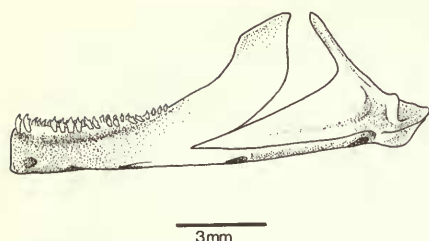


Fig. 4 *Haplochromis crocopeplus*. Left dentary and anguloarticular in lateral view.

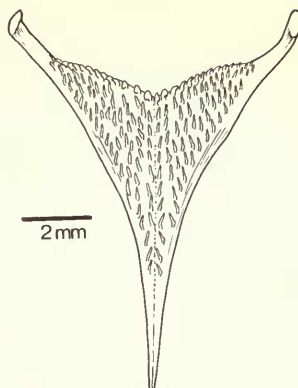


Fig. 5 *Haplochromis crocopeplus*. Lower pharyngeal bone in occlusal view.

An adult but sexually quiescent male (BM(NH) reg. no. 1977.1.28:38), see Fig. 7, has the dorsum of the body dark grey, the flanks, chest belly and caudal peduncle ochrous yellow; faint traces of a dark midlateral band are visible on the flanks. The head is yellowish grey, the opercular series grey.

The dorsal fin is grey-yellow with sooty lappets, the anal reddish anteriorly, pale grey-yellow posteriorly, its egg dummies (anal ocelli) yellow. The caudal fin is yellowish with dark rays and a red flush ventrally, the pectorals are hyaline with dark rays, and the pelvics sooty with an ochrous flush.

*Preserved material.* Adult males have a light brown ground coloration, darkest from the dorsum to about the level of the upper lateral line; in some specimens the ventral aspects of the body, and the entire caudal peduncle, are dusky or dusky overlying silver. Very faint indications of dark vertical bars are present on the flanks and caudal peduncle, the bars never extending as far as the dorsal body outline and sometimes not to the ventral outline either; in other specimens the bars merge with the dark coloration of the belly. The lower jaw and branchiostegal membrane are sooty, the vertical limb of the preoperculum dusky silver to black. The dorsal surface of the snout is dusky, and there is a very faint lachrymal stripe extending from the orbit to the lower jaw, passing immediately behind the posterior tip of the maxilla.

The dorsal fin is sooty-grey, the lappets black; the caudal is sooty, with the pigment most intense along its middle rays. The anal fin is light sooty, the pelvics black and the pectorals greyish.

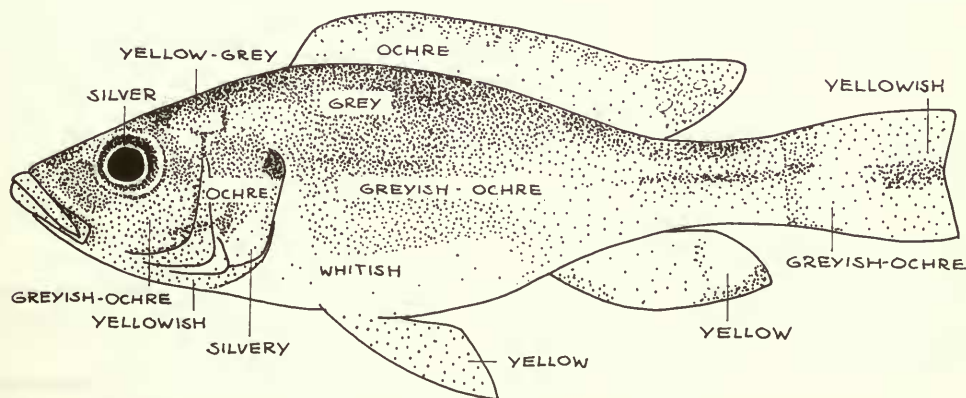


Fig. 6 *Haplochromis crocopeplus*. Adult female, showing coloration. Drawn by M. J. P. van Oijen

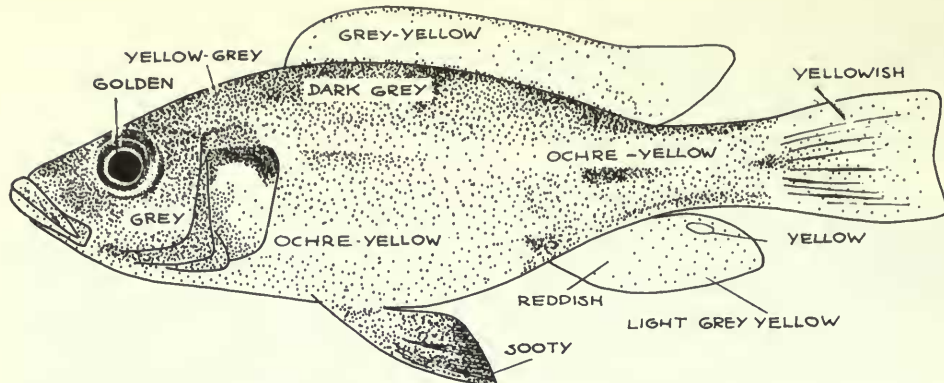


Fig. 7 *Haplochromis crocopeplus*. Adult male (sexually quiescent), showing coloration. Drawn by M. J. P. van Oijen.

*Adult females* have a light brown (almost fawn) ground coloration above the midlateral line, and are lighter fawn below. The dorsal aspects of the snout are faintly dusky, the operculum has a faint silvery sheen over its ventral half to two-thirds. No definite lachrymal stripe is visible, although in most specimens there is an ill-defined darkened region in the position of a typical lachrymal stripe.

The dorsal and caudal fins are greyish, the latter almost sooty between the middle few rays; the dorsal has black lappets. The anal and pelvic fins are hyaline, the pectorals greyish.

**ECOLOGY.** *Habitat.* Most of the specimens of *H. crocopeplus* used in this description were caught in a trawl net shot northeast of Tefu Island in the Speke Gulf. The bottom there is of soft, mostly organic mud, and the water is *c.* 28 m deep. At least one other specimen (see p. 148) was caught at the entrance to the Mwanza Gulf (sandy bottom at 6 m).

**FOOD.** The entire alimentary tract of all 17 specimens examined was filled with an organic sludge composed mainly of partly decomposed blue-green algae, and diatom frustules. Since such decaying organic matter is typical of the mud-water interface in Lake Victoria, we suspect that the gut contents of these fishes do not, in fact, represent normal food intake. Rather, we consider it more likely that the captive fishes ingested large quantities of the light, flocculent mud through which the net was moving.

The intestine of *H. crocopeplus*, however, is relatively long (*c.* 2.3–2.5 times the standard length) with the greater part coiled. Such a gut morphotype is often associated with a diet of detrital matter and differs from that found in the previously described and essentially carnivorous species of the '*tridens*' group (see Greenwood & Gee, 1969).

**BREEDING.** No information is available on the reproductive habits of *H. crocopeplus*. Only one of the 17 specimens examined is definitely immature, a female 76.5 mm S.L. A male of 71.0 mm S.L. is adult and, apparently, sexually active. There is considerable variation in the extent to which the two ovaries are developed in sexually active fishes; in some, both ovaries are of equal size, in others the left ovary is so greatly reduced (the modal condition) as to appear non-functional, while in others it is only slightly reduced. (See also Greenwood & Gee, 1969: 38, 43, 47 & 51.)

Judging from the sample available to us, males and females reach the same maximum adult size.

**DIAGNOSIS AND AFFINITIES.** *Haplochromis crocopeplus* shows all the diagnostic features of an *H. tridens*-group member (see Greenwood & Gee, 1969; and p. 155 below). In addition to inter-specific differences in live coloration, *H. crocopeplus* can be distinguished from other species of that group as follows:

(i) From *Haplochromis tridens* (see Greenwood, 1967: 97, fig. 20) by its less steeply sloping dorsal head profile (30–35°, *cf.* 40–45°), slightly wider interorbital distance (18.0–22.0, *M* = 19.5%

head, cf. 15.0–19.5,  $M = 16.7\%$ ), more numerous teeth in the outer premaxillary series (74 cf. 66), more oblique mouth (30–35°, cf. horizontal to 10°) and its less elliptical eye.

(ii) From *Haplochromis dolichorhynchus* (see Greenwood & Gee, 1969 : 34, fig. 21) by the slightly steeper slope of its dorsal head profile (30–35°, cf. 20–30°), its shorter snout (29.0–31.0,  $M = 30.0\%$  of head, cf. 30.3–38.0,  $M = 34.2\%$ ), slightly larger eye (28.0–33.0,  $M = 30.0\%$  head, cf. 25.9–29.6,  $M = 27.2\%$ ), somewhat more oblique mouth (30–35°, cf. 15–25°), greater posterior extension of the maxilla and by the less marked beak-like expansion of the premaxilla.

(iii) From *Haplochromis chlorochrous* (see Greenwood & Gee, 1969 : 44, fig. 27) by its slightly longer head (34.0–38.0,  $M = 36.0\%$  of standard length, cf. 32.0–35.4,  $M = 34.0\%$ ), very slightly shorter snout (29.0–31.0,  $M = 30.0\%$  head, cf. 29.5–35.0,  $M = 32.3\%$  head) and slightly larger eye (28.0–33.0,  $M = 30.0\%$  head, cf. 25.4–29.0,  $M = 28.2\%$ ).

Both species have similarly oblique mouths and similar dorsal profiles. A minor osteological difference lies in the more concave lateral aspect of the dentary in *H. crocopeplus* (see Greenwood & Gee, 1969 : 46; and p. 144 above). *Haplochromis crocopeplus* appears to have fewer unicuspid and more bi- and tricuspid teeth in its outer tooth rows, especially that of the upper jaw, but this may be a size correlated feature since many specimens in the *H. chlorochrous* sample examined are larger than the available specimens of *H. crocopeplus*. In life, adult male coloration seems to distinguish immediately between the two species.

(iv) From *Haplochromis tyrianthinus* (see Greenwood & Gee, 1969 : 40, fig. 25) by its slightly deeper body (29.0–35.0,  $M = 33.0\%$  standard length cf. 27.3–32.6,  $M = 30.6\%$ ), straight dorsal head profile (albeit one sloping at a similar angle), somewhat wider interorbital space (18.0–22.0,  $M = 19.5\%$  head, cf. 15.2–18.3,  $M = 17.4\%$ ) larger eye (28.0–33.0,  $M = 30.0\%$  head, cf. 26.1–29.3,  $M = 27.7\%$ ), and more oblique mouth (30–35° cf. 15–20°).

(v) From *Haplochromis cryptogramma* (see Greenwood & Gee, 1969 : 48, fig. 30) by the distinctive colour pattern of that species, which is retained even in preserved material, and also by the noticeably concave dorsal head profile in *H. cryptogramma*, by the slightly narrower interorbital width in *H. crocopeplus* (18.0–22.0,  $M = 19.5\%$  head, cf. 20.3–23.9,  $M = 22.0\%$ ), by its slightly shorter snout (29.0–31.0,  $M = 30.0\%$  head, cf. 28.6–35.5,  $M = 33.0\%$ ), deeper cheek (17.0–25.0,  $M = 21.0\%$  head, cf. 15.8–21.5,  $M = 19.0\%$ ) slightly larger and more elliptical eye (28.0–33.0,  $M = 30.0\%$  head, cf. 25.8–31.6,  $M = 28.7\%$ ), more steeply inclined mouth (30–35°, cf. 10–15°) and the greater number of teeth in the outer premaxillary row (70–80,  $M = 74$ , cf. 50–78,  $M = 68$ ).

(vi) From *Haplochromis sulphureus* (see below, p. 148, Fig. 8), a species which it closely resembles in most morphometric features, by differences in head shape, especially its more steeply inclined mouth (30–35°, cf. 10–15°), its larger scales between the dorsal fin origin and the lateral line (5½–6, cf. 6–7½, mode 7) and its larger chest scales (5½–7, mode 6, cf. 7–8, mode 8, scales between the pectoral and pelvic fin bases).

The two species also differ in live coloration and in their habitats, with *H. sulphureus* apparently confined to deeper water (see p. 150 below).

(vii) From *Haplochromis plutonius* (see p. 151 and Fig. 11 below) by its slightly longer snout (29.0–31.0,  $M = 30.0\%$  head, cf. 27.0–30.0,  $M = 29.0\%$ ) and lower jaw (41.0–50.0,  $M = 47.0\%$  head, cf. 41.0–46.0,  $M = 44.0\%$ ). The two species differ markedly in the live colours of adult males (cf. pp. 144 and 153), a difference that is also reflected in the darker coloration of preserved specimens.

Little can be said about the phyletic relationships of *H. crocopeplus* within the 'tridens' species complex, except to note that its overall neurocranial morphology (see p. 144) suggests a less derived condition than that of the other species (remembering, of course, that the cranial osteology of *H. plutonius* is still unknown; see p. 153), as does the relatively slight beak on the premaxilla (see p. 144). The well-developed flare on the dentary (p. 144), however, is probably a derived condition and one shared with at least 5 species of the group (*viz.* *H. cryptogramma*, *H. dolichorhynchus*, *H. tridens* and *H. sulphureus*).



## STUDY MATERIAL AND DISTRIBUTION RECORDS

Museum and Reg. No.	Locality	Collector
	TANZANIA	
BM(NH) 1977.1.10:70 (Holotype)	Speke Gulf, between Nafuba and Tefu Islands (28 m, mud)	Anker & Barel
BM(NH) 1977.1.10:71-87 (Paratypes)	Speke Gulf, between Nafuba and Tefu Islands (28 m, mud)	Anker & Barel
BM(NH) 1977.1.18:38 (Paratype)	Entrance of Mwanza Gulf (14m, sand)	Anker & Barel
BM(NH) 1977.1.28:39 (Paratype)	Speke Gulf, N.E. of Tefu Island (28 m, mud)	Anker & Barel

*Haplochromis sulphureus* sp. nov.

HOLOTYPE. An adult and sexually active male, 97.0 mm S.L., trawled over a mud bottom at a depth of c. 57 m in Ugandan waters at 0°45' S, 32°38' E. BM(NH) reg. no. 1977.1.10:106.

The trivial name (from the Latin) refers to the sulphur-yellow adult coloration in both sexes.

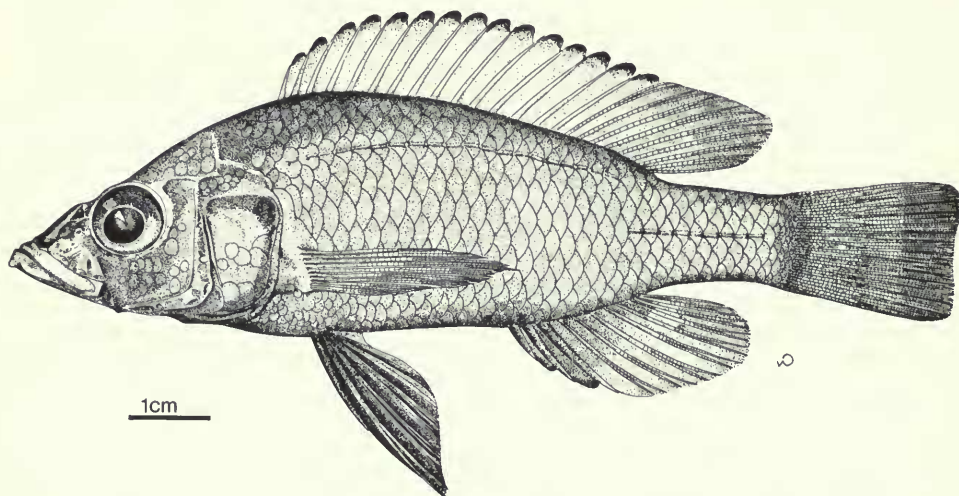


Fig. 8 *Haplochromis sulphureus*. Holotype. Drawn by M. J. P. van Oijen.

DESCRIPTION (Figs 8-10). Based on 22 specimens (including the holotype), 90.0-109.0 mm S.L.

Depth of body 29.0-35.0 ( $M=32.5$ )% of standard length, length of head 33.0-37.0 ( $M=35.0$ )%.

Dorsal head profile straight or slightly decurved, sloping at an angle of 30-35°; cephalic lateral line pores prominent, the pores and tubules of the preorbital bone especially so.

Preorbital depth 13.0-18.0 ( $M=15.0$ )% of head, least interorbital width 16.0-19.0 ( $M=17.0$ )%. Snout as long as broad to slightly longer than broad (1.1 times), its length 29.0-33.0 ( $M=31.0$ )% of head. Orbit and eye slightly elliptical, the eye with a narrow but definite anterior and antero-ventral aphakic aperture; eye diameter 28.0-33.0 ( $M=31.0$ )% of head. Depth of cheek 18.0-21.0 ( $M=19.0$ )%.

Caudal peduncle 15.0-20.0 ( $M=18.0$ )% of standard length, 1.3-1.8 (modal range 1.5-1.6) times longer than deep.

Mouth inclined at an angle of 10-15°, the posterior tip of the maxilla reaching a vertical through the anterior orbital margin or slightly beyond that level; lower jaw projecting beyond the upper anteriorly. Premaxilla with a moderately to well-developed antero-medial expansion of its dentigerous arm, giving the bone a distinctly beaked appearance; the dentary has a prominent mental protuberance. Length of lower jaw 44.0-50.0 ( $M=47.0$ )% of head, 1.8-2.6 (modal range 2.0-2.3) times its width.

*Gill rakers*. 9 or 10 on the lower part of the first gill arch, the lower 1-3 rakers reduced, the next 2 or 3 relatively slender, and the remainder flattened and branched, often anvil-shaped.

*Scales.* Ctenoid; lateral line with 32 (f.4), 33 (f.11), 34 (f.4) or 35 (f.2) scales. Cheek with 3 (mode) or 4 rows. Six and a half (mode) or 7 scales between the lateral line and the dorsal fin origin, 7–8 between the pectoral and pelvic fin bases.

*Fins.* Dorsal with 23 (f.3), 24 (f.12) or 25 (f.7) rays, comprising 15 (f.17) or 16 (f.5) spines and 8 (f.4), 9 (f.15) or 10 (f.3) branched rays. Anal with 10 (f.1), 11 (f.14) or 12 (f.7) rays, comprising 3 spines and 7 (f.1), 8 (f.14) or 9 (f.7) branched rays. Pectoral fin 25.5–31.0 ( $M=29.0$ )% of standard length. Pelvic fins with the first branched ray produced in both sexes. Caudal truncate, scaled on its proximal third (rarely) to half.

*Teeth.* The *outer row* in *both jaws* commonly has an admixture of bicuspid (some weakly so), unicuspid and tricuspid teeth; in a few specimens no tricuspid are present, and in others unicuspid are absent. Tricuspid teeth are generally confined to the lateral and posterior parts of the tooth row, with only bi- and unicuspid occurring anteriorly. Irrespective of cusp type, the teeth have compressed and slightly recurved crowns, and near-cylindrical necks.

There are 70–82 ( $M=76$ ) teeth in the outer row of the upper jaw.

Teeth in the *inner rows* of *both jaws* are small, tricuspid, compressed and somewhat obliquely implanted; those of the upper jaw are arranged in 2 (mode) or 3 series, and those of the lower jaw in 1 or 2 (mode) series.

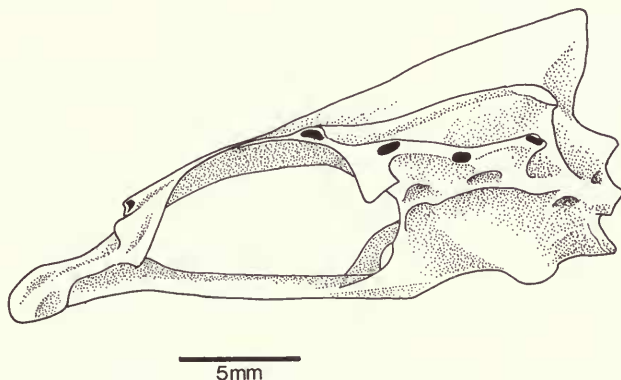


Fig. 9 *Haplochromis sulphureus*. Neurocranium in left lateral view.

*Osteology.* The neurocranium (Fig. 9) is of the typical 'tridens'-group type, with a low supra-occipital crest and a relatively protracted preorbital (ethmovomerine) face.

The lateral face of the *dentary* is markedly flared, the resulting concavity extending forward to the symphyseal area, the lower part of which is produced into a noticeable mental process.

The *premaxilla* is moderately beaked and its ascending processes (pedicels) are a little shorter than the dentigerous arms.

The *lower pharyngeal bone* (Fig. 10) is slender, with a narrow dentigerous surface that is slightly broader than long. When compared with the lower pharyngeal bone in other members of the 'tridens' group, that of *H. sulphureus* appears to be relatively broader. The *lower pharyngeal teeth* are slender, compressed and cuspidate, and are arranged in from 28 to 30 rows.

There are 30 vertebrae (excluding the fused  $PU_1$  and  $U_1$  centra), comprising 13 abdominal and 17 caudal elements, in the 11 specimens radiographed.

*Coloration.* In life only slight differences exist between the colours of adult males and females, although it must be remembered that information on live coloration was obtained from fishes that had been in a trawl net for as long as half an hour before they were examined.

The ground colour is a bright sulphur yellow, shading to silvery-white on the belly, and darkening to near olivaceous on the dorsum and upper flanks. In most *males* the chest, belly, lower jaw and branchiostegal membrane are sooty.

The dorsal and caudal fins are a deep yellow, the former with black lappets and a black margin to the soft part of the fin. In *females* the anal and pelvic fins are also deep yellow, but in *males* the anal has a sooty overlay and the pelvics are black. The anal ocelli (egg dummies) of males are yolk-yellow in colour.

*Preserved coloration.* *Adult males* have a uniformly bright yellow-brown ground coloration except for some individuals in which the chest and belly are darker and may even be sooty. No trace of vertical or horizontal bars is visible on the body in most specimens but a few do show either extremely faint traces of 4 or 5 vertical bars on the flanks, or a faint, interrupted dark midlateral stripe.

The dorsal aspect of the snout is a very dark brown, as is the lower jaw and the vertical limb of the preoperculum. There is no distinct lachrymal bar, although that region of the cheek and snout shows a diffuse darkening. The branchiostegal membrane is sooty in most fishes but is a very light yellowish-brown in others; this feature, like the sooty chest and belly, is probably correlated with the degree of sexual activity.

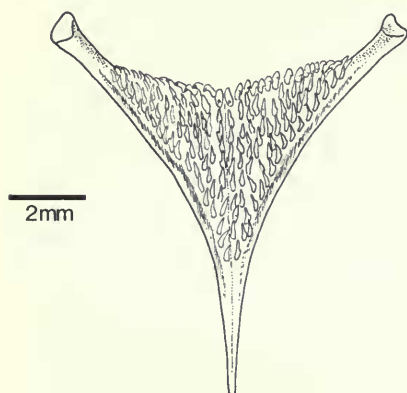


Fig. 10 *Haplochromis sulphureus*. Lower pharyngeal bone in occlusal view.

The dorsal and caudal fins are greyish-yellow, the lappets of the former are black; the anal fin is yellowish-brown (lighter than the body) but with a sooty overlay in some individuals, the colour intensifying to fully black over the spinous part of the fin. Pelvic fins sooty to black, the intensity being directly correlated with the degree of darkening manifest on the ventral aspects of the body. Pectoral fins are yellowish-hyaline.

*Adult females* are almost uniformly light yellowish-brown, but are slightly darker on the dorsum and much darker on the dorsal aspects of the snout. A very faint and narrow midlateral stripe is present on at least the posterior third of the body, and may extend further anteriorly.

The dorsal and caudal fins are greyish-yellow, the lappets of the dorsal black. The anal and pelvic fins are yellow, and the pectorals greyish-yellow.

**ECOLOGY.** *Habitat.* The five stations from which *H. sulphureus* were obtained are in the northern part of Lake Victoria (0°38'–0°50' S); the water is from c. 16–20 m deep, and the bottom of soft mud.

**FOOD.** Of the 15 specimens examined, two contained unidentifiable sludge, one the remains of dipteran pupae and some fragments of unidentifiable crustaceans, one the remains of dipteran larvae and some fragmentary crustacean remains, another the remains of both dipteran larvae and pupae, and two only fragments of unidentifiable crustaceans.

**BREEDING.** No information is available on the reproductive habits of *H. sulphureus*. All the 22 specimens available are adult and most are sexually active; females appear to reach a larger adult size than do males. Sexually active females may have the left ovary much better developed and larger than the right one (the usual condition), the ovaries may be of equal size or, as in one fish, the right ovary may be larger than the left one.



DIAGNOSIS AND AFFINITIES. In addition to interspecific differences in its adult male coloration, *H. sulphureus* can be distinguished from other members of the '*tridens*' group as follows:

(i) From *H. tridens* (see Greenwood, 1967 : 97, fig. 20) by its less steeply sloping dorsal head profile (30–35°, cf. 40–45°), shallower preorbital (13.0–18.0,  $M=15.0\%$  head, cf. 16.0–21.0,  $M=17.0\%$ ), smaller scales between pectoral and pelvic fin bases (7–8 cf. 5–6½ (mode)) and by its stouter lower jaw.

(ii) From *H. dolichorhynchus* (see Greenwood & Gee, 1969 : 34, fig. 21) by its more obviously elliptical eye, the absence in preserved female specimens of a distinct midlateral stripe, and by the smaller scales between the dorsal fin origin and the lateral line (6–7½, mode 7, cf. 5–6½, mode 5½). Although there is considerable interspecific overlap in all morphometric characters, the mean values of certain features in *H. sulphureus* indicate that this species does have a deeper caudal peduncle, a deeper preorbital, a larger eye and a shorter snout. (The means for the three latter characters, expressed as a percentage of head length, are: 15.0 cf. 18.0, 31.0 cf. 27.0 and 31.0 cf. 34.0 respectively).

(iii) From *H. chlorochrous* (see Greenwood & Gee, 1969 : 44, fig. 27) by its less oblique mouth (10–15°, mode 10°, cf. 20–35°, mode 30°), less prominent premaxillary pedicels, smaller scales between the dorsal fin origin and the lateral line (6–7½, mode 7, cf. 5½–6½, mode 6), shallower cheek (18.0–21.0,  $M=19.0\%$  head, cf. 20.0–25.0,  $M=22.6\%$ ) and larger eye (28.0–33.0,  $M=31.0\%$  head, cf. 25.4–29.0,  $M=28.2\%$ ).

(iv) From *H. tyrianthinus* (see Greenwood & Gee, 1969 : 40, fig. 25) by its less decurved dorsal head profile, smaller scales between the dorsal fin origin and the lateral line (6–7½, mode 7, cf. 5–6, mode 5½), shallower cheek (18.0–21.0,  $M=19.0\%$  head, cf. 20.0–25.3,  $M=22.9\%$ ) and its larger eye (28.0–33.0,  $M=31.0\%$  head, cf. 26.1–29.3,  $M=27.7\%$ ).

(v) From *H. cryptogramma* (see Greenwood & Gee, 1969 : 48, fig. 30) by the absence of distinctive midlateral markings of blotches and bands, by its much less prominent premaxillary pedicels, a convex or straight dorsal head profile (cf. a markedly concave one), an elliptical orbit, smaller scales between the dorsal fin origin and the lateral line (6–7½, mode 7, cf. 5–6½, mode 5½), and a narrower interorbital width (16.0–19.0,  $M=17.0\%$  head, cf. 20.3–23.9  $M=22.0\%$ ).

For features distinguishing *H. sulphureus* from *H. crocopeplus* and *H. plutonius* see pp. 147 and 155 for the species respectively.

The phyletic relationships of *H. sulphureus* within the *H. tridens* lineage as currently conceived cannot be determined precisely; there are some indications (especially from its coloration) that the species may be most closely related to *H. crocopeplus*.

#### STUDY MATERIAL AND DISTRIBUTION RECORDS

Museum and Reg. No.	Locality	Collector
	UGANDA	
BM(NH) 1977.1.10:106 (Holotype)	0°45' S, 32°38' E	P. H. Greenwood
BM(NH) 1977.1.10:107–108 (Paratypes)	0°44' S, 32°30' E	P. H. Greenwood
BM(NH) 1977.1.10:109–116 (Paratypes)	0°50' S, 32°35' E	P. H. Greenwood
BM(NH) 1977.1.10:117–121 (Paratypes)	0°39' S, 32°35' E	P. H. Greenwood

#### *Haplochromis plutonius* sp. nov.

HOLOTYPE. An adult male, 93.0 mm S.L., from a trawl made over a mud bottom in water *c.* 28 m deep, between Nafuba and Tefu Islands, Speke Gulf. BM(NH) reg. no. 1977.1.10:39.

The trivial name (from the Latin) refers to the dusky preserved coloration of adult males.

DESCRIPTION (Figs 11–13). Based on 10 specimens (including the holotype) 75.0–96.0 mm S.L.

Depth of body 29.0–33.0 ( $M=31.0\%$ ) of standard length, length of head 34.0–37.0 ( $M=35.0\%$ ).

Dorsal profile of head straight to a point above the preoperculum, then gently decurved, sloping at an angle of *c.* 30°, the premaxillary pedicels are prominent. The cephalic lateral line pores are enlarged, the pores and tubules of the preorbital bone and dentary being especially obvious.

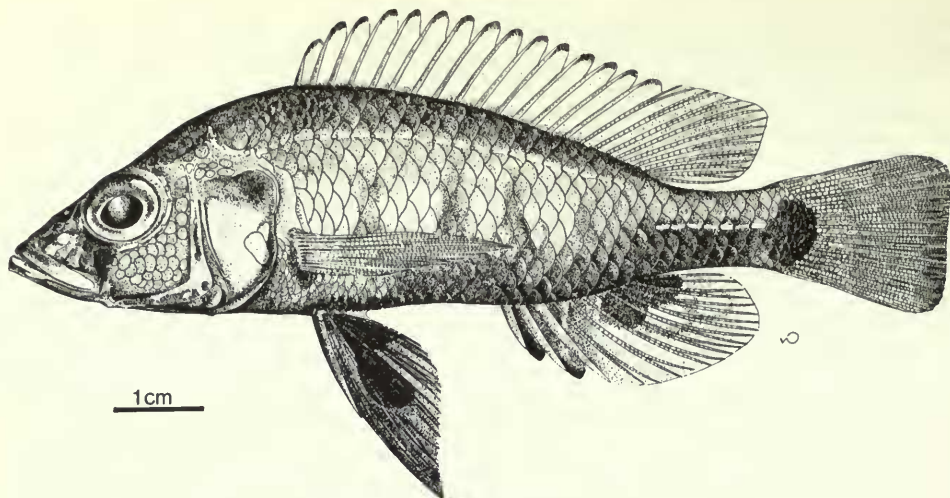


Fig. 11 *Haplochromis plutonius*. Holotype. Drawn by M. J. P. van Oijen.

Preorbital depth 15.0–17.0 ( $M = 16.0$ )% of head, least interorbital width 15.0–18.0 ( $M = 16.0$ )%. Snout as long as broad or very slightly longer than broad (1.1 times), its length 27.0–30.0 ( $M = 29.0$ )% of head. Eye and orbit distinctly elliptical, the eye with a well-developed anterior and anteroventral aphakic aperture; greatest diameter of eye 31.0–33.0 ( $M = 32.0$ )% of head. Cheek depth 16.0–21.0 ( $M = 19.0$ )%.

Caudal peduncle 1.4–1.8 (mode 1.6) times longer than deep, its length 16.0–19.0 ( $M = 18.0$ )% of standard length.

Mouth inclined at an angle of 10–15°; posterior tip of the maxilla reaching a vertical through the anterior margin of the eye or slightly beyond that level. Premaxilla with a moderately developed beak. Lower jaw projecting slightly beyond the upper, and with a moderately developed mental protuberance; length of lower jaw 41.0–46.0 ( $M = 44.0$ )% of head, 1.9–2.4 (modal range 2.0–2.1) times greater than its width.

*Gill rakers.* 8–10 (mode) on the lower part of the first gill arch, the lowermost 1–3 rakers reduced, the uppermost 3 or 4 flattened and usually anvil-shaped, the remaining rakers simple and moderately slender.

*Scales.* Ctenoid; lateral line with 32 (f.1), 33 (f.7) or 35 (f.1) scales, cheek with 3 or 4 rows. Five and a half to 7 (modal range 6–7) scales between the lateral line and the dorsal fin origin, 6–7 between the pelvic and pectoral fin bases.

*Fins.* Dorsal fin with 24 (f.9) or 25 (f.1) rays, comprising 15 (f.9) or 16 (f.1) spinous and 9 (f.9) or 10 (f.1) branched elements, anal with 11 (f.4) or 12 (f.6) rays, comprising 3 spines and 8 (f.4) or 9 (f.6) branched rays. Pectoral fin 26.0–30.0 ( $M = 29.0$ )% of standard length. Pelvics with the first branched ray moderately produced in both sexes. Caudal truncate, scaled on its basal half in most specimens, but not quite so extensively in a few others (only on the proximal third in one fish).

*Teeth.* The outer row in both jaws contains an admixture of bi- and tricuspid teeth; the teeth, irrespective of cusp shape, have compressed and slightly recurved crowns, and near-cylindrical necks. In most specimens the bicuspid teeth are situated anteriorly in the jaws, the lateral and posterolateral teeth being either all tricuspid or a mixture of tri- and bicuspids in which the tricuspid predominate. The exceptional individuals have a mixture of bi- and tricuspid anteriorly (the latter type predominating), although one specimen has only bicuspids in the outer row of both jaws.

There are 66–78 (modal range 70–74) teeth in the outer row of the upper jaw.

The inner teeth of both jaws are invariably small and tricuspid, are implanted obliquely and are arranged in 1 or 2 (mode) rows.

*Osteology.* Because so few specimens of *H. plutonius* are available, no complete skeleton has been prepared. Superficial dissection shows that the dentigerous surface of the *premaxilla* is moderately expanded medially, giving the bone a fairly definite beaked appearance. The dentigerous surface of the *dentary* is flared outward so that the lateral face of the bone is distinctly concave, with the concavity extending to the symphysial region of the bone.

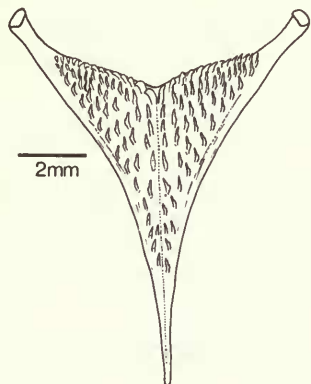


Fig. 12 *Haplochromis plutonius*. Lower pharyngeal bone in occlusal view.

The *lower pharyngeal bone* is noticeably narrow, slender and elongate (see Fig. 12); its dentigerous surface is either as broad as it is long or it may be slightly longer than broad. The *lower pharyngeal teeth* are fine, compressed and cuspidate, and are arranged in about 24 rows.

There are 29 (f.1), 30 (f.7) or 31 (f.1) vertebrae (excluding the fused  $PU_1$  and  $U_1$  centra) comprising 12 (f.1) or 13 (f.8) abdominal and 17 (f.8) and 18 (f.1) caudal elements.

*Coloration.* In life an *adult, sexually active male* (BM(NH) 1977.1.10:39) (see Fig. 13) has a purple ground coloration, with the ventral aspect of the flanks yellowish-grey, the chest and belly are dark grey to black, and the ventral part of the caudal peduncle a very dark grey. The head is purple except for a whitish opercular region, and a pinkish colour on the anterodorsal angle of the operculum and ventral preopercular limb; the branchiostegal membrane in sooty.

There is a faint lachrymal stripe, and three faint vertical bars on the flanks.

The dorsal fin is hyaline, with a grey base and broad, bright red streaks; the lappets are dark grey.

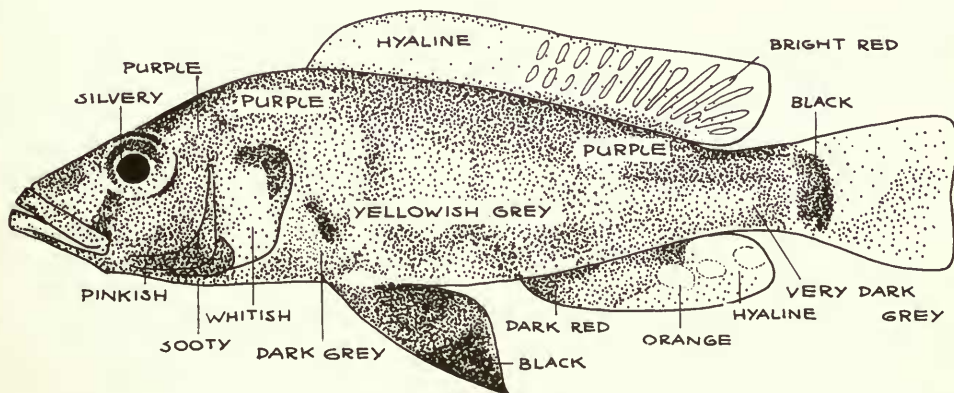


Fig. 13 *Haplochromis plutonius*. Adult male (sexually active), to show coloration. Drawn by M. J. P. van Oijen.



The anal fin has a red flush, becoming most intense on the anterior part of the fin (which may even appear to be black); the egg dummys are orange. The pelvic fins are black, the pectorals hyaline. The caudal fin is black basally, the dorsal half yellowish anteriorly but overlain by a red flush which intensifies over the ventral half of the fin.

The colours of *live females* are unknown.

*Preserved coloration. Adult males.* The dorsum and upper two-thirds of the flanks are dark brown, the belly and ventral aspects of the flanks dusky to sooty with a silvery-grey underlay. At least 4, sometimes 5 or 6, dark bars cross the flanks and merge with the darker ventral body colour (which is less intense than that of the bars); dorsally, the bars extend only to a level about two scale rows below the upper lateral line scale row. In some specimens there are very faint indications of an interrupted midlateral band, especially on the posterior part of the body.

The dorsal surface of the snout is a very dark brown (almost black); the branchiostegal membrane and the vertical limb of the preoperculum are black, the cheek brownish over silver, the operculum silver with a diffuse dusky overlay. A fairly distinct lachrymal stripe, of variable intensity, runs almost vertically, or with a slight anterior inclination, from the lower orbital margin to merge with the dark pigmentation of the lower jaw.

The dorsal fin is greyish to dusky, the lappets black and the soft part of the fin with dark spots and streaks between its rays. The caudal is dusky, darkest along its middle; the anal too is dusky, but with a black basal band and black pigment between the spines. The pelvic fins are black, and the pectorals faintly greyish.

*Adult females.* The dorsum is light brown, the remainder of the body silvery white; there are faint indications of a narrow midlateral stripe, most clearly discernible on the posterior half of the body.

The dorsal surface of the snout is very dark brown, the operculum is silvery and, save for a dark blotch anteroventrally to the orbit, there is no lachrymal stripe.

The dorsal and caudal fins are faintly sooty, the anal and pelvics hyaline, and the pectorals a faint grey.

**ECOLOGY. Habitat.** The species is known only from one locality in the Speke Gulf; the bottom is mud and the depth about 28 m. It is presumed that the specimens were caught while the trawl was fishing on the bottom.

**FOOD.** All 9 fishes examined had the entire alimentary tract filled with flocculent organic debris (decomposing blue-green algae). Since this type of material is typical of the mud-water interface we suspect that it was ingested while the specimens were caught in the trawl (see also pp. 146 & 168), and thus that it may not represent the natural food of *H. plutonius*.

The intestine of *H. plutonius* is relatively long (2 times standard length) and much coiled, suggesting that a certain amount of plant material may be part of the normal diet.

**BREEDING.** No information is available on the breeding habits of *H. plutonius*. All the 10 specimens examined were adult and sexually active. Of the two females represented in the sample, one has both ovaries equally developed, the other has only the right ovary enlarged.

**DIAGNOSIS AND AFFINITIES.** From *H. dolichorhynchus*, *H. tyrianthinus*, *H. chlorochrous* and *H. cryptogramma*, *Haplochromis plutonius* is differentiated by, amongst other features, its larger eye (31.0–33.0,  $M=32\%$  head) and shorter snout (27.0–30.0,  $M=29.0\%$  head); from *H. cryptogramma* it is also distinguished by the absence of a conspicuous broad and interrupted midlateral stripe, and by its straight, as opposed to markedly concave, dorsal head profile.

From *H. tridens*, *H. plutonius* is differentiated by its shorter lower jaw (41.0–46.0,  $M=44.0\%$  head, cf. 43.3–51.8,  $M=47.5\%$ ), its less steeply sloping but more concave dorsal head profile (c.  $30^\circ$  cf.  $40\text{--}45^\circ$ ) and its slightly shallower body (29.0–33.0,  $M=31.0\%$  standard length, cf. 30.1–36.2,  $M=33.5\%$ ). The preserved coloration of the two species also differs. When males with testes in a morphologically similar state of development (presumably sexually active) are compared, *H. tridens* lacks the dark pigmentation of *H. plutonius* (*H. tridens* are silvery, with black pelvic fins).

From *H. crocopeplus*, *H. plutonius* differs in the live coloration of its males and by having a

slightly shorter lower jaw (41.0–46.0,  $M=44.0\%$  head, cf. 41.0–50.0,  $M=47.0\%$ ) and less oblique mouth (10–15°, cf. 30–35°, mode 35°).

From *H. sulphureus*, *H. plutonius* differs in its somewhat shorter snout (27.0–30.0,  $M=29.0\%$  head, cf. 29.0–33.0,  $M=31.0\%$ ) and lower jaw (41.0–46.0,  $M=44.0\%$  head, cf. 44.0–50.0,  $M=47.0\%$ ); live adult male coloration is also diagnostic.

The phyletic affinities of *H. plutonius* within the '*tridens*'-group cannot yet be determined.

#### STUDY MATERIAL AND DISTRIBUTION RECORDS

Museum and Reg. No.	Locality	Collector
	TANZANIA	
BM(NH) 1977.1.10:39 (Holotype)	Speke Gulf, N.E. of Tefu Island	Anker & Barel
BM(NH) 1977.1.10:40–48 (Paratypes)	Speke Gulf, N.E. of Tefu Island	Anker & Barel

### Comments on the *Haplochromis tridens* species complex

The addition of three further species to this complex, now totalling 8 species, enables one to give a more precise definition of the lineage than hitherto, and to review its phyletic relationships (see Greenwood, 1974 for a preliminary analysis).

One of the most diagnostic group features is, of course, the presence of several to many tricuspid teeth in the outer row of at least one and usually both jaws, these teeth not being confined to an extreme posterior position in the row. The tricuspid teeth are sufficiently numerous, and of a size comparable with their bi- and unicuspid congeners, to exclude the possibility of their merely being teeth from the inner series that have moved outwards to fill the gaps caused by the loss of true outer row teeth.

In other Lake Victoria *Haplochromis* species a few tricuspid teeth may occur posteriorly in the outer series of the lower jaw or, less commonly, posteriorly in the upper jaw. These tricuspid teeth are never as numerous as those in members of the '*tridens*' group, and when they occur in the lower jaw are noticeably smaller than the teeth situated laterally and anteriorly. Often the tricuspid teeth are clearly displaced elements of the inner tooth series. Very occasionally one or two tricuspid teeth are found elsewhere in the outer rows of non-'*tridens*'-group *Haplochromis* species, but as mentioned above, these are never so numerous as are the tricuspid teeth in '*tridens*' species.

The tricuspid outer teeth in members of the '*tridens*'-group can be considered a derived (and autapomorphic) feature, although their functional significance (if any) remains unknown.

Other apomorph, but not necessarily autapomorphic features shared by all members of the group are apparent in the skeleton.

The skull has slender proportions, with a low otico-occipital (brain case) region, low supra-occipital crest, and a relatively elongate ethmovergine region, all of which give the neurocranium a characteristic appearance (see Figs 3 & 9 above, and relevant figures in Greenwood, 1974).

The preorbital bone has greatly enlarged lateral line canals and pores (Fig. 8) and, especially characteristic, a large, nearly rectangular bullation occupying almost the entire anterior portion of the bone between its margin and the first lateral line tubule. Apparently this outpocketing is associated with the relatively enlarged dorsal articular head of the maxilla, which it overlies. Enlarged preorbital lateral line tubules are, of course, found in many *Haplochromis* species, especially those inhabiting deeper or turbid waters, but the extensive preorbital bulla seems to be an autapomorphic feature of the '*tridens*'-group. (Some species belonging to other groups, e.g. *Haplochromis nanoserranus* of the *Haplochromis serranus* lineage, see p. 158 below, also have an anterior bullation of the preorbital. However, it is always relatively smaller, appears more circumscribed and is approximately circular in outline.)

The dentary in '*tridens*'-group species has a very characteristic shape (Fig. 4), low and slender but with the coronoid region rising steeply to meet the deep anguloarticular bone.

All members of the group have a narrow and slender lower pharyngeal bone (Fig. 5) with an elongate anterior blade and numerous fine, compressed and cuspidate teeth.



Ecologically, the '*tridens*' species appear to be members of the sublittoral to benthic community, the greater number of species occurring in water between 15 and 30 m deep. No clear picture has emerged yet of their feeding habits. Some species feed on pre-adult insects (especially Diptera) and adult crustaceans (see Greenwood, 1967; Greenwood & Gee, 1969; Greenwood, 1974), while others may be detritus feeders (see pp. 146 & 154 above); certain of these latter species have a relatively elongate and much coiled intestine, anatomical features often associated with that type of diet and feeding habit.

No member of the group can be considered to reach a large adult size, a standard length of 120 mm being the largest so far recorded (for *H. chlorochrous*, see Greenwood & Gee, 1969). Because of their habitat preferences and their small adult size, species of the '*tridens*' group have only been caught in small-mesh trawl nets; to the best of our knowledge none has been recorded from the catches of beach-operated seine nets or from commercially-operated set-nets.

On the basis of various derived characters shared by all known species of the '*tridens*' complex, a strong argument can be put forward for considering the group as a monophyletic assemblage within the Lake Victoria species flock. Some anatomical features (neurocranial morphology in particular) indicate close affinity with the *H. serranus* and *Haplochromis prognathus* lineages, probably as the sister group of the two latter lineages combined (see Greenwood, 1974). In his preliminary phyletic analysis of the Lake Victoria *Haplochromis* species, Greenwood (1974) also suggested the existence of a relationship between, on the one hand, the '*tridens*' group plus the lepidophagous *Haplochromis welcommei*, and on the other hand, the insectivorous-molluscivorous lineage comprising *Haplochromis riponianus*, *H. saxicola* and *H. aelocephalus* (the three lineages together forming the sister group to the combined *H. serranus* and *H. prognathus* lineages).

For the moment no further comments can be made about possible relationships between *H. welcommei* and the '*tridens*' group. However, taking into account relative specializations seen in the neurocranium of '*tridens*' species when compared with the less specialized neurocranial form of the *H. riponianus* group, and also taking into account the autapomorph features of the two groups (see Greenwood, 1974), an argument could be made against their having a recent common ancestry (but not against the *H. riponianus* group sharing more distant ancestry with both the '*tridens*' group and the *H. serranus*-*H. prognathus* group). In other words, the '*tridens*' group may share a more recent common ancestry with the *H. serranus*-*H. prognathus* lineage than with the *H. riponianus*-*H. aelocephalus* one.

Basically, neurocranial form in the '*tridens*' group is like that in the *H. serranus*-*H. prognathus* lineage, but is somewhat less specialized (see Greenwood, 1974); the lower pharyngeal bone and dentition, the form of the lower jaw, the dentition in both jaws, and the large preorbital bulla housing the enlarged maxillary dorsal articular process, however, are peculiarly '*tridens*' specializations.

Most adult fishes in the '*tridens*' lineage differ from those in the '*serranus*' group in having a narrow interorbital, a slightly to much shorter snout (*H. dolichorhynchus* is exceptional in this respect), a larger eye and a shallower cheek. Essentially the same features distinguish '*tridens*' group species from those of the '*prognathus*' line, although the intergroup differences in snout length and interorbital width are less pronounced.

Eye size and cheek depth are, in general, negatively correlated characters, and invariably eye size shows negative allometry with body length. It is thus the more unfortunate that, with few exceptions, we were unable to compare specimens of the '*tridens*' group with similar sized members of the '*serranus*' and '*prognathus*' groups. We would suggest, nevertheless, that the intergroup differences in eye and cheek proportions are probably a consequence of the very different modal adult sizes for the two groups, and that some factor controlling size at maturity may have been involved in their evolutionary histories.

We have been unable to find any features within the '*tridens*' group that can be used to establish intragroup phylogenies (a situation very familiar to the senior author amongst the more speciose lineages of Lake Victoria *Haplochromis*; see Greenwood, 1974).

It is still not possible to determine whether or not *Haplochromis arcanus* Greenwood & Gee, 1969, is a member of the '*tridens*' lineage. That none of the dental specializations found in



*H. arcanus* (especially the strongly incurved posterolateral teeth of the premaxilla) occurs in any of the new 'tridens' species, seems to add further weight to the argument that *H. arcanus* is not a member of that group (see Greenwood & Gee, 1969). Its proximate relationship to the 'tridens' lineage, through the shared common ancestry of that lineage with the *H. serranus*-*prognathus* line, still seems to be the most reasonable hypothesis.

When *H. dolichorhynchus*, *H. chlorochrous*, *H. tyrianthinus* and *H. cryptogramma* were first described, no radiographs could be made of the material and hence no vertebral counts were given for the species; this can now be rectified. As usual the fused  $PU_1$  and  $U_1$  centra are not included in the counts.

*H. dolichorhynchus*: 29 (f.1) or 30 (f.8) comprising 12 (f.1) or 13 (f.8) abdominal, and 16 (f.1), 17 (f.7) or 18 (f.1) caudal elements.

*H. chlorochrous*: 29 (f.3) or 30 (f.7), comprising 12 (f.1) or 13 (f.9) abdominal and 16 (f.3), 17 (f.6) or 18 (f.1) caudal elements.

*H. tyrianthinus*: 30 (f.6) or 31 (f.2), comprising 13 abdominal and 17 (f.6) or 18 (f.2) caudal elements.

*H. cryptogramma*: 29 (f.2), 30 (f.6) or 31 (f.2), comprising 12 (f.1) or 13 (f.9) abdominal and 16 (f.1), 17 (f.7) or 18 (f.2) caudal elements.

### New species of the *H. serranus* group

#### *Haplochromis nanoserranus* sp. nov.

**HOLOTYPE.** An adult male 76.0, standard length, from the Mwanza Gulf, caught in a trawl shot near the eastern end of the Muranda peninsula and fished towards the northwestern point of Luansa Bay; substrate sandy mud, water depth c. 4–8 m. BM(NH) reg. no. 1977.1.10:54.

The trivial name is from the Latin *nanus*, a dwarf, and *serranus*, with reference to *H. serranus* (Pfeffer).

**DESCRIPTION** (Figs 14 & 15). Based on 6 specimens (including the holotype), 72.0–76.0 mm standard length. All specimens are adult males.

Depth of body 30.0–33.0 ( $M=31.8$ ) % of standard length, length of head 31.0–35.0 ( $M=33.7$ ) %.

Dorsal head profile straight, sloping at an angle of 30–35°; the snout profile, when viewed laterally, is noticeably acute and the premaxillary pedicels are prominent. The cephalic lateral line pores, except those of the preorbital and dentary, are not noticeably enlarged; the pre-

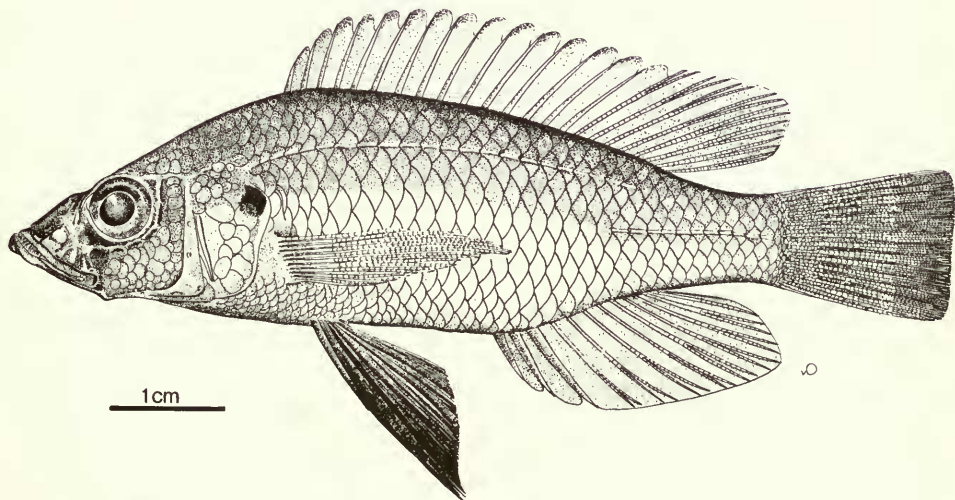


Fig. 14 *Haplochromis nanoserranus*. Holotype. Drawn by M. J. P. van Oijen.

orbital lateral line tubules are as obvious as those of species in the *H. tridens* group and there is also a small anterior bullation of that bone (see above p. 155).

Preorbital depth 16.0–18.0 ( $M = 17.0$ )% of head, least interorbital width 16.0–18.0 ( $M = 17.0$ )%. Snout varying from a little broader than long to slightly longer than broad (1.1 times), its length 29.0–31.0 ( $M = 30.2$ )% of head. The eye and orbit are noticeably elliptical, the former with a fairly well-developed anterior and anteroventral aphakic aperture; greatest diameter of eye 25.0–32.0 ( $M = 29.0$ )% of head. Cheek depth 17.0–22.0 ( $M = 19.3$ )%.

Caudal peduncle 1.6–1.9 (mode 1.6) times longer than deep, its length 18.0–21.0 ( $M = 19.0$ )% of standard length.

Mouth moderately oblique, inclined at an angle of 20–35° (mode *c.* 30°); posterior tip of the maxilla generally reaching a vertical through the anterior part of the eye, but sometimes only reaching a vertical through the anterior orbital margin. Premaxilla with its dentigerous arm somewhat expanded anteroposteriorly in the midline, giving the bone a moderately beaked appearance, jaws equal anteriorly. Dentary with a fairly prominent mental process. Lower jaw 2.3–2.8 times longer than broad, its length 45.0–52.0 ( $M = 47.0$ )% of head.

*Gill rakers.* 9 or 10 on the lower part of the first gill arch, the lower 1–3 rakers reduced, the remainder variously shaped but usually slender, except for the uppermost 2 or 3 which are generally flattened and either bifid or anvil-shaped.

*Scales.* Ctenoid; lateral line with 32 (f.2) or 33 (f.4) scales, cheek with 3 or 4 rows. Six or 6½ scales between the lateral line and the dorsal fin origin, 6–7 (mode 6½) between the pectoral and pelvic fin bases.

*Fins.* Dorsal with 24 (f.1) or 25 (f.5) rays, comprising 14 (f.1), 15 (f.3) or 16 (f.2) spinous and 8 (f.1), 9 (f.2) or 10 (f.3) branched elements. Anal with 12 (f.6) rays comprising 3 spines and 9 branched rays. Pectoral fin 26.0–31.0 ( $M = 28.5$ )% of standard length. Pelvics with the first branched ray moderately to strongly produced. Caudal truncate, scaled on its basal half.

*Teeth.* In both jaws the majority of teeth in the outer row are slender, somewhat recurved and caniniform unicuspid. A few bi- and weakly tricuspid teeth occur posteriorly and posterolaterally in the lower jaw but none was found in the upper jaw.

The occurrence of a predominantly unicuspid and caniniform outer tooth row in such small fishes is most unusual (see Greenwood, 1974: 106); for example, in *Haplochromis pellegrini*, the only other member of the *H. serranus*–*H. prognathus* species complex with small adults, fishes less than 85 mm S.L. usually have a predominance of bi- and weakly bicuspid teeth in the outer row, and only a few unicuspid present anteriorly in the jaws.

The inner teeth, which are implanted obliquely, may all be tricuspid, or a mixture in which tricuspid predominate over unicuspid and weakly tricuspid teeth, or even one in which unicuspid predominate. The tricuspid teeth have compressed crowns but cylindrical necks, the unicuspid are somewhat compressed.

There are 2 or, rarely, 3 rows of inner teeth in the upper jaw, and 1 or 2 rows in the lower jaw.

*Osteology.* No complete skeleton is available, and but little information about the details of neurocranial architecture could be obtained from radiographs. The supraoccipital crest (at least as compared with that in specimens of the *H. tridens* group) is relatively high.

Superficial dissection shows that the preorbital bone has a small and clearly circumscribed bulla near its anterior border, and that the dentigerous surface of the dentary is flared outwards so that the lateral face of the bone is markedly concave; the concavity does not, however, extend forward to the symphyseal region.

The lower pharyngeal bone (Fig. 15) has its dentigerous surface broader than long; its teeth are fine and cuspidate, and are arranged in about 28 rows.

There are 29 (f.1) or 30 (f.5) vertebrae (excluding the fused  $PU_1$  and  $U_1$  centra), comprising 13 abdominal and 16 or 17 caudal elements.

*Coloration.* The live coloration of this species is unknown, and preserved colours are known only for adult males.

The body above the midlateral line, the entire head except for the operculum, and the entire caudal peduncle are a light greyish-brown. Below the midlateral line (i.e. on the chest, belly and ventral flanks) the colour changes to silvery grey with, in a few specimens, a darker, almost dusky

chest region. Some specimens have a broad, but faintly indicated midlateral band which is interrupted at about its midpoint and becomes broader over its posterior half. This band appears to extend onto the caudal fin (whose middle portion may be darker than the rest of the fin even in specimens lacking a midlateral stripe). The operculum is silvery (except for a typical opercular spot in its posterodorsal angle), the dorsal and anterolateral aspects of the snout are dusky, as are the median and mediolateral aspects of the upper lip, and there is a faint and relatively narrow lachrymal stripe running onto the lower jaw behind the posterior tip of the maxilla.

The dorsal and caudal fins are greyish, the membrane of the soft dorsal sometimes weakly maculate. The anal is hyaline to greyish, its ocelli (egg dummies) dead white. The pelvic fins are black, and the pectorals hyaline.

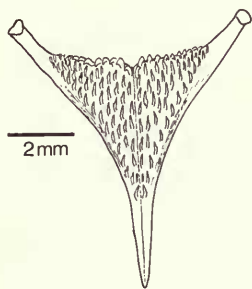


Fig. 15 *Haplochromis nanoserranus*. Lower pharyngeal bone in occlusal view.

**ECOLOGY. Habitat.** The specimens on which this description is based are all from shallow (c. 4–8 m) offshore waters, and were caught over a muddy sand substrate. (The senior author recalls examining specimens of a similar and probably identical taxon caught in similar habitats in the northern and eastern regions of the lake; regrettably, this material was lost in transit from east Africa to Britain.)

**FOOD.** One of the specimens examined had the remains of a small cichlid fish in its intestines; two others contained fragments of larval insects (in one fish larval Diptera, in the other what appeared to be the remains of a larval boring mayfly, *Povilla adusta*), and the remaining two fishes yielded only an unidentifiable sludge in both the stomach and intestines.

**BREEDING.** Apart from the fact that all 6 specimens are small (72–76 mm S.L.) and are sexually active males, nothing is known about the reproductive habits of this species.

**DIAGNOSIS AND AFFINITIES.** At first sight, specimens of *H. nanoserranus* closely resemble members of the *H. tridens* species complex. However, detailed examination shows that, unlike 'tridens' species, *H. nanoserranus* has only unicuspid teeth in the outer series of the upper jaw, and a mixture of unicuspid and weakly bicuspid teeth in the lower jaw. Furthermore, the unicuspid teeth in *H. nanoserranus* are of the slender, near-cylindrical and caniniform type found in piscivorous predators of the *H. serranus*–*H. prognathus* lineage (see Greenwood, 1974), and not the more flattened, angular type characteristic of the 'tridens' group. Also, in *H. nanoserranus* the preorbital bone has only a small and well-circumscribed, nearly circular bulla, unlike the larger and vertically more elongate bulla of the 'tridens' type (see above, p. 155); the lower pharyngeal bone in *H. nanoserranus* (see Fig. 15) has not the slender and elongate form so characteristic of the 'tridens' group (cf. Fig. 15 and Fig. 5).

Unfortunately, no details are available on the syncranial architecture of *H. nanoserranus*, but judging from radiographs its neurocranium has essentially the outline and proportions of an *H. serranus*-group fish rather than the lower and more elongate type found amongst members of the 'tridens' group (see Greenwood, 1974 and p. 155 for a discussion of these neurocranial features).

Thus, at least for the moment, we are placing *H. nanoserranus* in the 'serranus' subdivision of the *H. serranus*–*H. prognathus* lineage of Greenwood (1974), but noting that it does show, at least incipiently, certain features seen in members of the *H. tridens* species complex.



When making comparisons between *H. nanoserranus* and members of the *H. serranus* group we were hampered by the fact that very few small specimens of species in that complex have been described or are available for study (see Greenwood, 1962 & 1967). Consequently the small but adult specimens of *H. nanoserranus* had to be compared with much larger and often juvenile specimens of the '*serranus*' group. If, as seems most likely, some of the diagnostic features we used are subject to allometric growth, then small specimens of '*serranus*' group species may resemble *H. nanoserranus* more closely than we realize at present.

From *H. serranus* itself (see Greenwood, 1962 : 152, figs 4 & 5), *H. nanoserranus* differs in having a longer and more slender caudal peduncle (18.0–21.0,  $M=19.0\%$  standard length, cf. 13.0–19.0,  $M=15.4\%$ , and 1.6–1.9, mode 1.6, times longer than deep, cf. 1.1–1.5, mode 1.2 times), a shorter head (31.0–35.0,  $M=33.7\%$  S.L., cf. 34.8–38.7,  $M=36.3\%$ ), a narrower interorbital (16.0–18.0,  $M=17.0\%$  head, cf. 20.4–26.8,  $M=23.3\%$ ), a larger eye (25.0–32.0,  $M=29.6\%$  head, cf. 20.4–26.0,  $M=23.3\%$ ), a shallower cheek (17.0–22.0,  $M=19.3\%$  head, cf. 22.9–31.5,  $M=27.5\%$ ) and a shorter lower jaw (45.0–52.0,  $M=47.0\%$  head, cf. 48.0–60.0,  $M=54.3\%$ ).

From *Haplochromis victorianus* (see Greenwood, 1962 : 156, pl. 1) it differs in its shallower body (30.0–33.0,  $M=31.8\%$  S.L., cf. 33.4–41.3,  $M=37.3\%$ ), narrower interorbital (16.0–18.0,  $M=17.0\%$  head, cf. 21.5–24.5,  $M=22.6\%$ ), shorter snout (29.0–31.0,  $M=30.2\%$  head, cf. 31.8–36.0,  $M=34.0\%$ ), larger eye (25.0–32.0,  $M=29.0\%$  head, cf. 21.7–25.5,  $M=23.6\%$ ) and a shallower cheek (17.0–22.0,  $M=19.3\%$  head, cf. 22.5–26.2,  $M=24.6\%$ ).

From *Haplochromis maculipinna* (see Greenwood, 1967 : 43, fig. 3) it is differentiated by its shallower body (30.0–33.0,  $M=31.8\%$  S.L. cf. 33.3–37.0,  $M=35.9\%$ ), longer and shallower caudal peduncle (18.0–21.0,  $M=19.1\%$  S.L., cf. 14.5–18.8,  $M=16.3\%$ , and 1.6–1.9, mode 1.6, times longer than deep, cf. 1.2–1.8, mode 1.1–1.2 times), narrower interorbital (16.0–18.0,  $M=17.0\%$  head, cf. 20.7–25.5,  $M=22.8\%$ ), somewhat shorter snout (29.0–31.0,  $M=30.2\%$  head, cf. 30.3–37.0,  $M=33.7\%$ ) and shallower cheek (17.0–22.0,  $M=19.3\%$  head, cf. 23.2–29.8,  $M=25.3\%$ ).

It is interesting to note that the relative proportions of the eye diameter and lower jaw length are similar in the two species, despite the size discrepancy of the specimens examined.

From *Haplochromis boops* and *H. thuragnathus* (see Greenwood, 1967 : 47–51, fig. 4), *H. nanoserranus* differs in its much shallower body (30.0–33.0,  $M=31.8\%$  S.L., cf. 40.5–42.0 (no means given because *H. boops* and *H. thuragnathus* are known from so few specimens)), somewhat less steeply inclined dorsal head profile (30–35°, cf. 40–50°), narrower interorbital (16.0–18.0,  $M=17.0\%$  head, cf. 21.7–25.7%) and shallower cheek (17.0–22.0,  $M=19.3\%$  head, cf. 28.0–30.0%). The three species show complete overlap in the relative proportions of eye diameter and lower jaw length.

The three other previously known species of the *H. serranus* group (*Haplochromis plagiostoma*, *H. cavifrons* and *H. denticostoma*) are immediately distinguishable from *H. nanoserranus* on the basis of their gross morphology, especially their respective head shapes (compare Fig. 14 above with the figures of these species in Greenwood, 1962, and Greenwood & Gee, 1969 for *H. plagiostoma* and *H. cavifrons*, and *H. denticostoma* respectively).

From the other new and presumed member of the *H. serranus* complex, *Haplochromis cassius* (see below and Fig. 16). *H. nanoserranus* is readily distinguished by its finer, smaller and more numerous outer teeth, and by its less enlarged lips.

It is not yet possible to determine the phyletic relationships of *H. nanoserranus* within the *H. serranus* species group. The species does, however, seem to show the same morphological relationships with the congeners of its lineage as does *H. pellegrini* with its congeners in the *H. prognathus* lineage of the '*serranus-prognathus*' group (see Greenwood, 1974). In other words, it is a morphologically somewhat specialized 'dwarf' amongst a radiation of relative 'giants'.

## STUDY MATERIAL AND DISTRIBUTION RECORDS

Museum and Reg. No.	Locality	Collector
	TANZANIA	
BM(NH) 1977.1.10:54 (Holotype)	East of Muranda peninsula towards the northwestern point of Luansa bay, Mwanza Gulf	Anker & Barel
BM(NH) 1977.1.10:55-59 (Paratypes)	East of Muranda peninsula towards the northwestern point of Luansa bay, Mwanza Gulf	Anker & Barel

*Haplochromis cassius* sp. nov.

**HOLOTYPE.** An adult female, 97.5 mm S.L., from the southern part of the Mwanza Gulf off Busissi, at a depth of 2 m, over a mud bottom. BM(NH) reg. no. 1977.1.10:49.

The trivial name derives from Shakespeare's 'Julius Caesar' (Act I, scene II) '... Yond Cassius has a lean and hungry look ...'.

We are well aware of the dangers inherent in describing new taxa of Lake Victoria *Haplochromis* from small and unisexual samples; but the peculiar dentition and enlarged lips of this species are so distinctive that we feel justified in our actions.

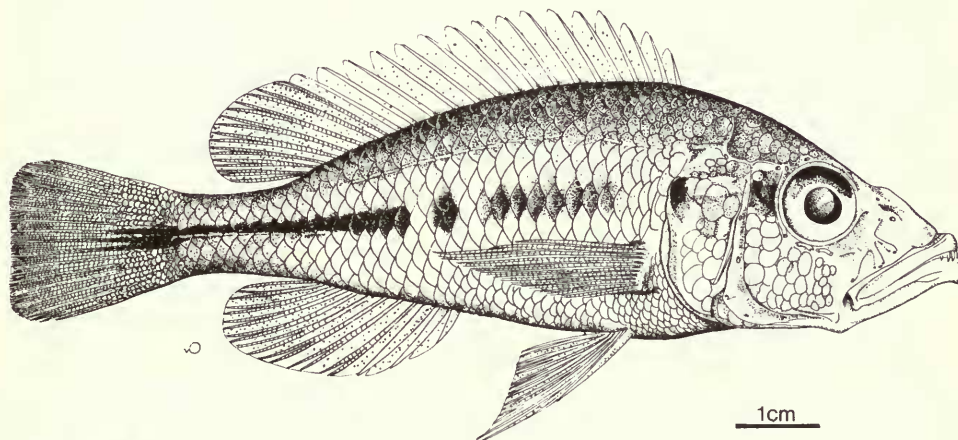


Fig. 16 *Haplochromis cassius*. Holotype. Drawn by M. J. P. van Oijen.

**DESCRIPTION** (Figs 16-18). Based on 5 specimens (including the holotype), 70.5-97.5 mm S.L. All are females.

Depth of body 29.0-34.0 ( $M=31.0$ )% of standard length, length of head 36.0-40.0 ( $M=37.0$ )%.

Dorsal head profile straight or gently decurved (its outline interrupted by the prominent premaxillary pedicels) and sloping at an angle of 30-40°. The cephalic lateral line pores, and the tubules on the preorbital bone, are not noticeably enlarged.

Preorbital depth 16.0-21.0 ( $M=18.0$ )% of head length, interorbital width 17.0-20.0 ( $M=18.0$ )%. Snout broader than long, its length 30.0-36.0 ( $M=33.3$ )% of head. Eye and orbit very slightly elliptical, the eye with a well-defined anterior and anteroventral aphakic aperture; eye diameter 26.0-31.0 ( $M=28.0$ )% of head. Cheek depth 20.0-22.0 ( $M=21.0$ )%.

Caudal peduncle 1.7-1.9 times longer than deep, its length 17.0-19.0 ( $M=18.0$ )% of standard length.

Mouth slightly oblique, inclined at an angle of 15-20°; jaws equal anteriorly, the posterior tip of the maxilla just reaching a vertical through the anterior margin of the eye. Premaxilla with a well-developed beak (i.e. a median anteroposterior expansion of its dentigerous arm). Both the upper and lower lips are noticeably thickened, more so than in any other species of the '*serranus*' group. The lower jaw 2.5-2.8 times longer than broad, its length 43.0-48.0 ( $M=44.0$ )% of head length; dentary without a marked mental protuberance.

*Gill rakers.* 10 or 11 (mode) on the lower part of the first gill arch, the lowermost 1 or 2 (exceptionally 4) reduced, the remainder slender except for the uppermost 2 or 3 which are flattened and bi- or tri- or polyfid.

*Scales.* Ctenoid; lateral line with 33 (f.3) or 34 (f.2) scales, cheek with 3 (f.2) or 4 (f.3) rows. Five to  $6\frac{1}{2}$  scales between the lateral line and the dorsal fin origin, 6 (mode) to 7 between the pectoral and pelvic fin bases.

*Fins.* Dorsal with 24 (f.1) or 25 (f.4) rays, comprising 15 (f.3) or 16 (f.2) spines and 9 (f.3) or 10 (f.2) branched rays. Anal fin with 12 rays, comprising 3 spines and 9 branched rays. Pectoral fin 26.0–28.0 ( $M=27.0$ )% of standard length. Pelvics with the first branched ray very slightly produced. Caudal truncate, scaled on its basal third to half.

*Teeth.* The *outer teeth* in both jaws are large, somewhat recurved, caniniform unicuspid and are very widely spaced. When the jaws are closed some teeth lie outside the lip of the opposing jaw, while others seem to become embedded in the gum and lip tissues of that jaw. This unusual condition may, of course, be merely a preservation artefact, and consequent upon the thickening of gum and lip tissues in the fixative.

There are only 30–40 teeth in the outer row of the upper jaw.

The *inner teeth* are mostly small unicuspid, but some weakly tricuspid teeth also occur in these series; all are obliquely implanted, and are arranged in 1 or 2 rather irregular rows in both jaws.

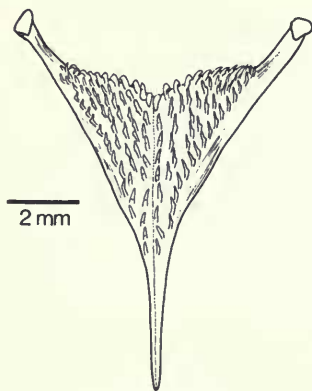


Fig. 17 *Haplochromis cassius*. Lower pharyngeal bone in occlusal view.

*Osteology.* No complete skeleton is available. The *lower pharyngeal bone* (Fig. 17) has its dentigerous surface very slightly longer than broad; its teeth are cuspidate and compressed, vary in form from fine to relatively robust (especially those near the midline) and are arranged in 24–26 rows. There are 30 (f.3) or 31 (f.2) vertebrae (excluding the fused  $PU_1$  and  $U_1$  centra), comprising 13 (f.4) or 14 (f.1) abdominal and 16 (f.1), 17 (f.2) or 18 (f.2) caudal elements.

*Coloration.* In life, an *adult but quiescent female* (BM(NH) reg. no. 1977.1.10:51, see Fig. 18) has the dorsum of the head dark grey-blue, the preorbital region, cheek, preoperculum and lips greyish, the operculum is silvery with a dark opercular blotch and the branchiostegal membrane whitish. The dorsum of the body is grey-blue anteriorly, lighter, almost silver posteriorly. The flanks are silver-grey, darkest anteriorly, with a dark midlateral stripe that is interrupted at about its midpoint. The chest, belly and caudal peduncle are silvery white, the dorsal aspect of the latter rather darker.

The dorsal and pectoral fins are hyaline, the pelvics hyaline, the anal fin grey-silver and the caudal hyaline.

Details of *preserved* coloration are available for *females* only (both immature and adult). The ground coloration is sandy-grey above the midlateral line (except the dorsum) and also on the head save for the cheeks and dorsum. Below the midlateral line the sandy-grey colour gradually becomes silvery-white. The dorsum of the head and body are dark brown, and the cheeks are silvery.



A broad and well-defined midlateral stripe (variously but narrowly interrupted) runs from behind the head to the basal part of the caudal fin. Immediately below the dark dorsum, and in places continuous with it, is an indistinct dark line which runs parallel to the dorsal outline of the body; posteriorly this line merges completely with the dark coloration of the back.

A faint, weakly V-shaped, bar crosses the snout at about the level of the lower orbital margin; in some specimens there is a short, faint and ill-defined lachrymal blotch.

All the fins are hyaline (except for a small area on the caudal where the midlateral band of the body terminates).

**ECOLOGY. Habitat.** The 5 specimens came from three different collecting stations in the Mwanza Gulf, viz. a point slightly south of the crossing between the Muranda peninsula and the opposite shore, at a depth of c. 4–6 m (no substrate data were recorded), another trawl haul near this area at a depth of c. 6–10 m over mud and, thirdly, a trawl made in the southern part of the gulf near Busissi, again over mud at a depth of only 2 m.

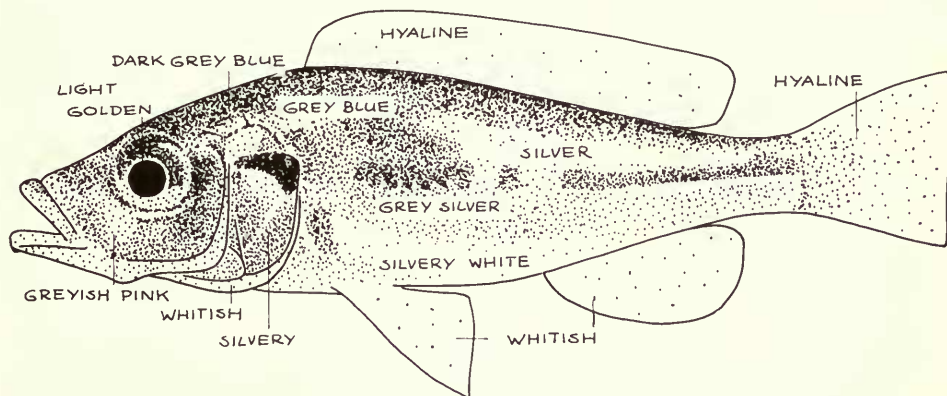


Fig. 18 *Haplochromis cassius*. Adult female (quiescent), to show coloration. Drawn by M. J. P. van Oijen.

**FOOD.** The feeding habits of *H. cassius* certainly cannot be determined from the small sample of guts examined, the more especially since the ingested matter is so heterogeneous. One of the 4 specimens examined was without food in any part of the gut. One fish had an empty stomach, but the remains of at least one small cichlid fish in the intestine. The other two specimens (both from the same locality and trawl haul) had the entire intestine packed with diatom frustules (mostly a colonial form resembling *Melosira*). One of these fishes had a similar diatom mass in its stomach, but the stomach of the other fish was empty.

It is difficult to account for the almost purely diatom intake of these two fishes other than by assuming that they had actively selected the diatoms as food. The nature of the gut contents certainly does not suggest that the material had been ingested while the fishes were impounded in the net and being dragged through the flocculent organic mud at the mud-water interface (see above, pp. 146 & 154) because this interface is unlikely to be composed purely of diatoms (and only one taxon at that). The organic constituents of the near-liquid mud are predominantly blue-green algae, with diatoms (and particularly the *Melosira* type of diatoms) forming but a small proportion of the whole.

Much more material of *H. cassius* will have to be examined, and more details about the substrate obtained, before this particular trophic puzzle can be solved.

The intestine of *H. cassius* is of moderate length (c.  $1\frac{1}{2}$  times S.L.) and thus more typical of a predatory than a herbivorous species.

**BREEDING.** No information is available on the reproductive habits of *H. cassius*. In the one sexually active fish represented in our sample, the right ovary is much larger than the left one, although the latter does have near full-term ova present in it.

DIAGNOSIS AND AFFINITIES. *Haplochromis cassius* is readily distinguished from all other members of the *H. serranus*–*H. prognathus* lineage (see Greenwood, 1974), and all other species with a 'predatory' facies, by its noticeably thickened lips and by its well-spaced, caniniform teeth some of which, at least in preserved specimens, are visible when the mouth is closed. This species also differs from members of the *H. serranus*–*H. prognathus* complex in having a shorter lower jaw, narrower interorbital, shallower cheek, larger eye (but this possibly a correlate of its small adult size), and a higher gill raker count (modal number of rakers 11, cf. 9 for the other species, in a few of which 10 rakers have been counted in the occasional specimen).

If *H. nanoserranus* (see above, p. 159) is also a member of the *H. serranus* group, it too has a narrower interorbital, larger eye and a shallower cheek, but again the adult size of this species is much smaller than that for other members of the group. *Haplochromis nanoserranus* does, however, have a lower jaw length and a gill raker count more typical for the *H. serranus* group than does *H. cassius*.

Until more anatomical information is available for *H. cassius* its relationships within the *H. serranus* species complex remain indeterminable except as a dentally specialized offshoot of this lineage.

#### STUDY MATERIAL AND DISTRIBUTION RECORDS

Museum and Reg. No.	Locality	Collector
	TANZANIA	
BM(NH) 1977.1.10:49 (Holotype)	Southern part of the Mwanza Gulf near Busissi (2 m)	Anker & Barel
BM(NH) 1977.1.10:50 (Paratype)	Southern part of the Mwanza Gulf near Busissi (2 m)	Anker & Barel
BM(NH) 1977.1.10:51 (Paratype)	Mwanza Gulf, slightly south of Muranda peninsula (c. 4–6 m)	Anker & Barel
BM(NH) 1977.1.10:52–53 (Paratypes)	Mwanza Gulf near previous station but at a depth of c. 6–10 m	Anker & Barel

### A new species of the *H. empodisma*–*H. obtusidens* group

#### *Haplochromis ptistes* sp. nov.

HOLOTYPE. An adult male 98.0 mm S.L. from the Speke Gulf northeast of Tefu Island (between Tefu and Nafuba Islands), at a depth of c. 28 m over a mud bottom. BM(NH) reg. no. 1977.1.10:60.

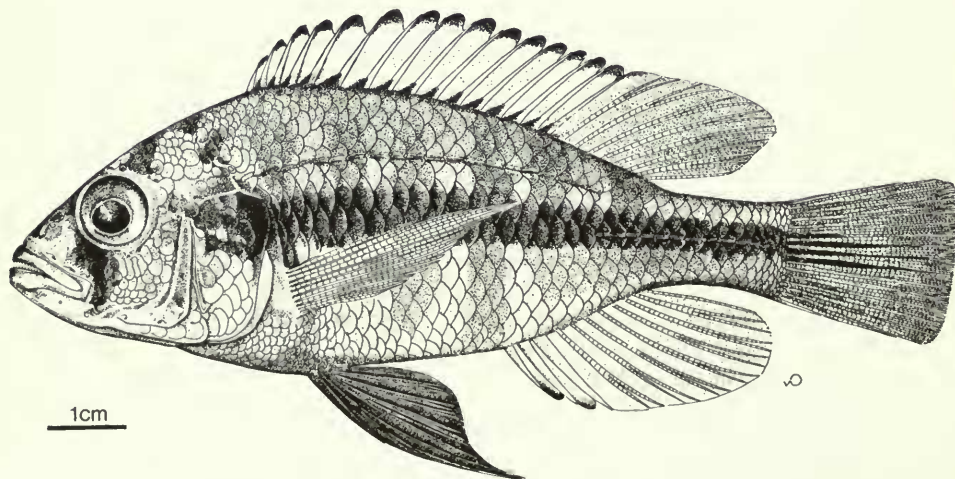


Fig. 19 *Haplochromis ptistes*. Holotype. Drawn by M. J. P. van Oijen.

The trivial name (from the Greek meaning a winnower or sheller) refers to the crushing pharyngeal mechanism of this species and the effect it has on its molluscan prey.

**DESCRIPTION** (Figs 19–21). Based on 10 specimens (including the holotype) 90.0–106.0 mm standard length.

Depth of body 38.6–42.0 ( $M=40.0$ )% of standard length, length of head 34.2–37.6 ( $M=36.0$ )%.

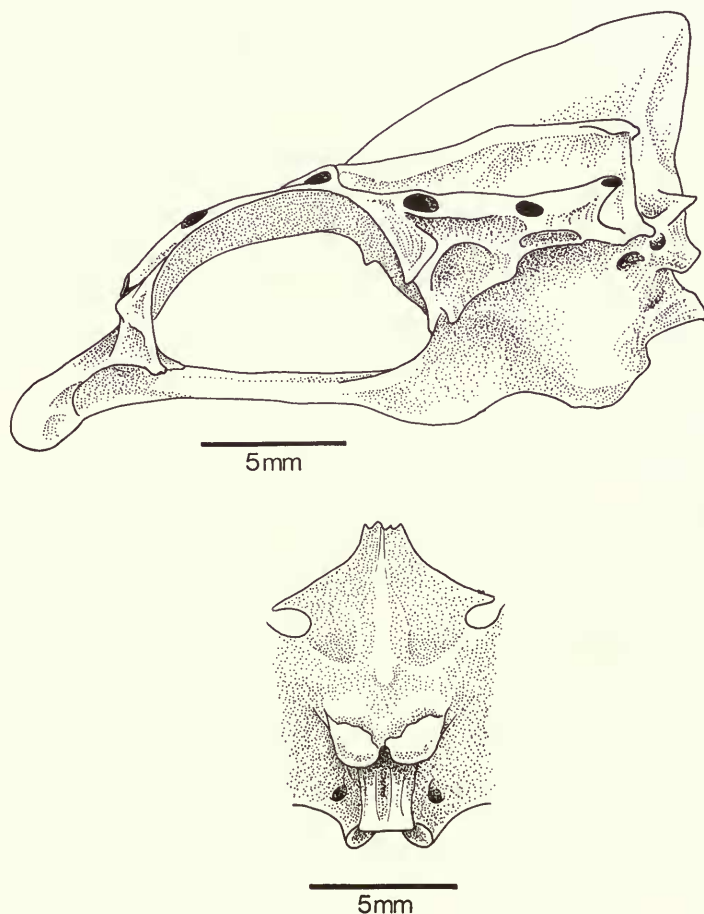
Dorsal head profile gently decurved and sloping at an angle of 35–40°. The cephalic lateral line pores, and the tubules on the preorbital bone, are moderately enlarged and prominent.

Preorbital depth 14.7–17.4 ( $M=16.4$ )% of head length, least interorbital width 23.5–26.0 ( $M=24.7$ )%. Snout broader than long, its length 29.4–32.4 ( $M=30.6$ )% of head. Orbit and eye virtually circular, the eye with a fairly definite anterior and anteroventral aphakic aperture and, in some specimens, a more definite posterior one as well; eye diameter 26.5–32.4 ( $M=30.0$ )% of head. Cheek depth 20.5–24.3 ( $M=22.0$ )%.

Caudal peduncle 1.3–1.6 (modal range 1.4–1.5) times longer than deep, its length 15.0–18.0 ( $M=16.4$ )% of standard length.

Jaws equal anteriorly, mouth almost horizontal, the posterior tip of the maxilla reaching a vertical through the anterior margin of the eye; premaxilla with a slight median anteroposterior expansion of its dentigerous arm giving it a slightly beaked appearance.

Lower jaw 1.5–1.9 (mode 1.5) times longer than broad, its length 37.3–41.2 ( $M=39.0$ )% of head.



**Fig. 20** *Haplochromis ptistes*. Above, neurocranium in left lateral view. Below, the apophysis for the upper pharyngeal bones.



*Gill rakers.* 8 (mode) or 9 on the lower part of the first gill arch, the lower 1–3 rakers reduced, the remainder short and moderately stout to stout.

*Scales.* Ctenoid; lateral line with 31 (f.1), 32 (f.7) or 33 (f.2) scales, cheek with 3 (mode) or 4 rows. Five to  $6\frac{1}{2}$  (usually 6 or  $6\frac{1}{2}$ ) scales between the dorsal fin origin and the lateral line, 6 or 7 (mode) between the pectoral and pelvic fin bases.

*Fins.* Dorsal with 23 (f.3) or 24 (f.7) rays, comprising 14 (f.2), 15 (f.4) or 16 (f.4) spines and 8 (f.5) or 9 (f.5) branched rays. Anal with 11 (f.9) or 12 (f.1) rays, comprising 3 spines and 8 (f.9) or 9 (f.1) branched rays. Pectoral 86.6–97.0 ( $M=92.0$ )% of head length. Pelvic fins with the first branched ray produced, proportionately more so in males than in females. Caudal truncate, scaled on its basal third to half (mode).

*Teeth.* In most specimens less than 100 mm S.L. the *outer teeth* in the *upper jaw* are unequally bicuspid (some weakly so), relatively stout and slightly recurved; the posterior few teeth, however, are unicuspid and slightly enlarged. Specimens over 100 mm S.L. (and one fish of 90 mm S.L.) have mostly stout unicuspid teeth throughout the series. Teeth in the outer row of the *lower jaw* are similar to those in the upper jaw although some bicuspids may occur in larger specimens and a few unicuspids in smaller individuals.

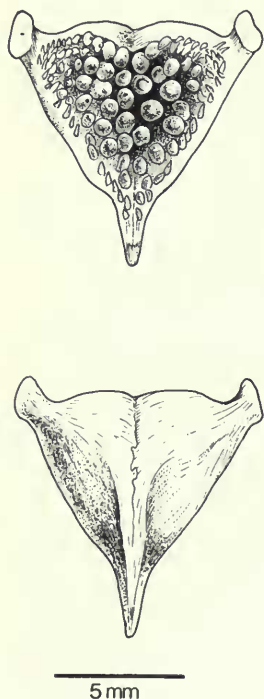


Fig. 21 *Haplochromis ptistes*. Lower pharyngeal bone in occlusal view (above), and in ventral view (below).

There are 60–70 (mode *c.* 65) teeth in the outer row of the upper jaw.

The teeth of the *inner rows* in both jaws are small, compressed, tricuspids, arranged in 2 rows in the upper jaw and a single (sometimes irregular) row in the lower jaw.

*Osteology. Neurocranium.* The neurocranium of *Haplochromis ptistes* (Fig. 20) shows a close overall resemblance to that of *Haplochromis obtusidens* (see Greenwood, 1960 : 267, and 1974, figs 43 & 65). The dorsal profile is straight and slopes at a moderate angle, in these respects differing somewhat from the neurocranial type found in the other mollusc-crushing lineage represented by *Haplochromis ishmaeli* and *H. pharyngomylus* (see Greenwood, 1974 : 74, fig. 43). Here the orbital region is relatively high-vaulted, and consequently the preorbital profile is somewhat decurved and slopes more steeply than in *H. ptistes*.

The apophysis for the upper pharyngeal bones (Fig. 20) in this species is rather stouter and has a larger articular surface than the apophysis in *H. obtusidens*, but it is smaller and has a lesser contribution from the basioccipital than does the apophysis of *H. ishmaeli* or *H. pharyngomylus*.

The lower pharyngeal bone (Fig. 21) is stout, with the majority of its teeth enlarged and molariform; only those teeth contributing to the marginal row, and those situated in the posterolateral angles of the bone, are distinctly cuspidate and not particularly enlarged. The bone has a characteristic outline shape (Fig. 21) with a marked shoulder occurring a little posterior to the point where the bone narrows to form the anteriorly directed blade. In lateral view the occlusal surface is gently concave over its entire area.

When compared with the pharyngeal bones of *H. ishmaeli* and *H. pharyngomylus* (and in one of the new species described below, p. 176), that of *H. ptistes* is relatively less hypertrophied and its teeth are also less massive. However, its dentigerous area is relatively larger and there are somewhat more molariform teeth than in *H. obtusidens*.

In other words, the lower pharyngeal bone and dentition of *H. ptistes* occupy a morphologically intermediate position between those of the lineages represented by *H. ishmaeli* and *H. pharyngomylus* on the one hand, and by *H. obtusidens* on the other.

The dentary in *H. ptistes* is relatively shallow and elongate, resembling that in *H. obtusidens* rather than the dentary of *H. ishmaeli* or *H. pharyngomylus*.

There are 28 (f.2) or 29 (f.2) vertebrae (excluding the fused  $PU_1$  and  $U_1$  centra) in the 4 specimens radiographed, the total comprising 12 (f.2) or 13 (f.2) abdominal and 16 caudal elements.

**Coloration.** The live colours of *H. ptistes* are unknown. **Preserved coloration. Adult males.** The dorsum is yellowish-brown shading to a lighter tone on the flanks; the belly and chest are dusky. A dark, horizontally aligned blotch extends from immediately behind the eye posteriorly across the operculum where it deepens slightly and becomes confluent with, or is narrowly separated from, a broad midlateral stripe on the flank. This stripe may narrow or be interrupted at about the middle of the body; posteriorly it extends onto the caudal fin, the hind margin of which it reaches. Some specimens show traces of 3 or 4 broad vertical bars on the lower flanks and belly; very faint traces of these bars continue onto the upper flanks and back. In other specimens the bars are barely visible.

The head has two definite black bars across the snout, the upper one extending from orbit to orbit. A supraorbital stripe runs obliquely upwards from the dorsoposterior margin of the orbit almost to the midline, where it is narrowly separated from its partner of the opposite side; in most specimens the supraorbital bars are virtually rectangular in outline but in a few they are roughly triangular (but never so definitely triangular as in *Haplochromis teegelaari*, see p. 173 below).

A broad lachrymal band runs almost vertically downwards onto the anguloarticular region of the lower jaw or even further ventromedially. The branchiostegal membrane is dusky in some specimens, but pale in others.

A bar of variable intensity and completeness extends vertically upwards from a point almost at the middle of the upper opercular margin; the bar of each side meets, albeit faintly, or is narrowly separated from, its counterpart. In several specimens there is a well-defined black bar following the outline of the preoperculum, but in others it is extremely faint.

The dorsal fin is greyish, with black lappets on the spinous part and dark maculae on the soft part of the fin. The caudal is darkly maculate, especially over its upper half, and has a dark midlateral streak. The anal fin is greyish, and the pelvics are black.

**Adult females** have a pale yellow-brown ground colour, with the chest, belly and operculum silvery (the latter with a large dark blotch at its posterodorsal angle). There is a faint but distinct dark midlateral stripe extending from the preopercular margin to the posterior margin of the caudal fin. The lachrymal stripe is very faint and short.

The dorsal and caudal fins are greyish, the former with black lappets, the latter with a midlateral stripe, and faint maculae on its upper half. The anal and pelvic fins are hyaline.

**ECOLOGY. Habitat.** All 10 specimens came from a single trawl haul made in the Speke Gulf, between Tefu and Nafuba Islands, at a depth of c. 28 m over a mud bottom.

FOOD. Of the 8 specimens examined, 4 contained only flocculent organic detritus (principally blue-green algae with some diatoms and green algae) throughout the entire alimentary tract. The other 4 specimens contained, in addition to this detrital matter, fragments of mollusc shells (either of unidentifiable bivalves together with the gastropod *Melanoides tuberculata*, or of the bivalves alone).

As with the other species from this station and haul (see p. 146), the detritus may have been ingested whilst the fishes were being dragged through the mud-water interface during capture.

The intestine of *H. ptistes* is very long (c.  $2\frac{1}{2}$  times the standard length) and much coiled, an unusual feature for a species with the hypertrophied pharyngeal apparatus of a mollusc eater.

BREEDING. Nothing is known about the reproductive habits of *H. ptistes*. All the specimens available are adult and none is sexually active. The single female caught (90 mm S.L.) has its ovaries in an advanced stage of oogenesis, the right ovary being slightly larger than the left one.

DIAGNOSIS AND AFFINITIES. *Haplochromis ptistes* is distinguished from all previously described species with hypertrophied pharyngeal bones and teeth by the outline shape of its lower pharyngeal bone (see Fig. 21) and by the following characters for the species severally:

(i) From *H. obtusidens* (see Greenwood, 1960 : 266, fig. 18) by its more massive lower pharyngeal bone and the more extensive molarization of its lower pharyngeal dentition, its larger eye (26.5–32.4,  $M=30.0\%$  head, cf. 24.3–30.8,  $M=27.2\%$ ), slightly longer snout 29.4–32.4,  $M=30.6\%$  head, cf. 26.0–31.0,  $M=28.5\%$ ), shallower cheek (20.5–24.3,  $M=22.0\%$  head, cf. 21.2–30.0,  $M=26.7\%$ ), longer pectoral fin (86.6–97.0,  $M=92.0\%$  head, cf. 73.5–103.0,  $M=86.8\%$ ) and by the markedly different pattern of cephalic markings visible in preserved adult males. (Live colours of *H. ptistes* are unknown.)

(ii) From *H. ishmaeli* and *H. pharyngomylus* (see Greenwood, 1960 : 270–279, figs 19–21) by the presence of definite snout and supraorbital markings in preserved specimens, by its larger eye (26.5–32.4,  $M=30.0\%$  of head, cf. 23.0–31.8,  $M=26.5$  and 23.0–31.0,  $M=27.7$  for *H. pharyngomylus* and *H. ishmaeli* respectively), the greater number of teeth in the outer row of the upper jaw (modal number 65, cf. 44–52 and 36 for *H. ishmaeli* and *H. pharyngomylus* respectively), the straight preorbital profile of the neurocranium, the less massive lower pharyngeal bone, and by its higher modal number of gill rakers (8 cf. 7); *H. ptistes* is further distinguished from *H. pharyngomylus* by its longer pectoral fin (86.6–97.0,  $M=92.0\%$  head, cf. 68.5–91.0,  $M=79.6\%$ ) and by the greater posterior extension of its maxilla (reaching a vertical through the anterior part of the eye in *H. ptistes*, but only to the orbital margin, or not even to that level, in *H. pharyngomylus*).

From the two newly discovered species with hypertrophied pharyngeal mills (see pp. 169–174 below), *H. ptistes* is distinguished as follows:

(i) From *H. tegelaraai* (see p. 169: Figs 22–27) by its snout being broader than long, by differences in the neurocranial architecture (dorsal preorbital profile straight, compared with a more obviously vaulted and curved orbital-preorbital region; cf. Figs 20 and 24), the slightly less massive ventral apophysis, with a smaller articular area for the upper pharyngeal bones cf. Figs 20 and 25), the less markedly concave occlusal surface of the lower pharyngeal bone and by the rectangular as opposed to triangular supraorbital markings in preserved males. (The well-defined midlateral body stripe of *H. ptistes* seemingly is also diagnostic in preserved material.)

The degree of lower pharyngeal bone enlargement, and the extent to which its teeth are molarized, are similar in both species, but the bone of *H. ptistes* has a very characteristic shape when seen in occlusal view (cf. Figs 21 & 26). The two species show a virtually complete overlap in the mean values of all morphometric features except that of relative snout width (see above).

(ii) From *Haplochromis mylergates* (p. 174, Figs 29–31), *H. ptistes* is readily distinguished by its less massive lower pharyngeal bone, which also lacks the deeply concave occlusal surface seen in *H. mylergates*, by differences in skull architecture (similar to those distinguishing *H. ptistes* from *H. tegelaraai*, see above and also Figs 20 & 24), by the more gradually pointed snout as seen in dorsal view (see Fig. 23), and by differences in preserved coloration, especially the absence in *H. mylergates* of prominent cephalic markings (save for the lachrymal stripe).

On the basis of its neurocranial shape, and its relatively shallow dentary (as compared with the more generalized skull shape and deeper dentary of *H. ishmaeli*, *H. pharyngomylus* and *H.*



*mylergates*, and the generalized skull shape of *H. teegelaari*), *H. ptistes* is thought to be a member of the *H. empodisma*–*H. obtusidens* lineage of mollusc crushing species (see Greenwood, 1974), probably the derived (apomorph) sister species of *H. obtusidens*. In addition to showing certain derived morphological features, *H. ptistes* should perhaps also be considered specialized because of its relatively deeper water habitat.

#### STUDY MATERIAL AND DISTRIBUTION RECORDS

Museum and Reg. No.	Locality	Collector
	TANZANIA	
BM(NH) 1977.1.10:60 (Holotype)	Speke Gulf, between Tefu and Nafuba Islands, c. 28 m	Anker & Barel
BM(NH) 1977.1.10:61–69 (Paratypes)	Speke Gulf, between Tefu and Nafuba Islands, c. 28 m	Anker & Barel

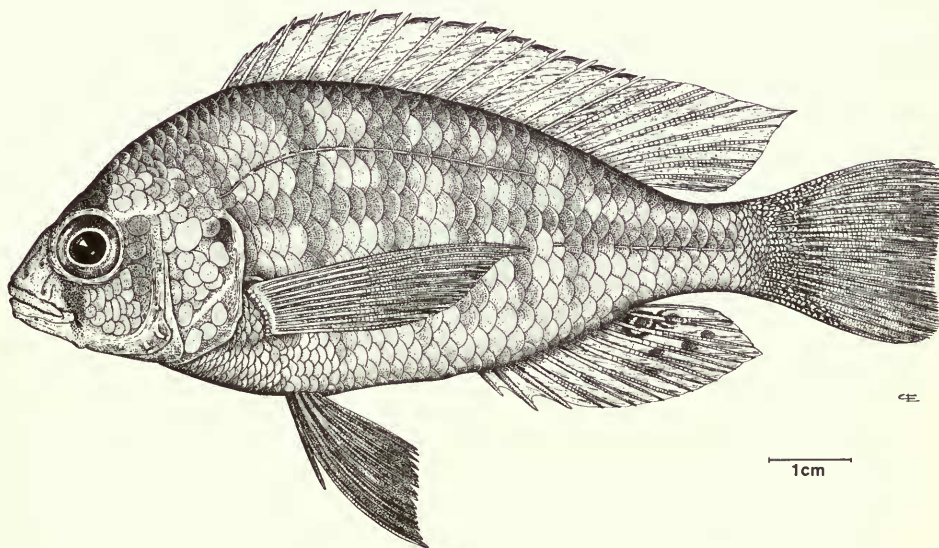
### New species of the *H. ishmaeli*–*H. pharyngomylus* group

#### *Haplochromis teegelaari* sp. nov.

**HOLOTYPE.** An adult male 93.0 mm standard length, from the southern part of the Mwanza Gulf near Busissi, caught over a mud bottom at a depth of c. 2 m. BM(NH) reg. no. 1977.1.10:16.

The species is named in honour of the late Nico Teegelaar, an outstanding Dutch biological artist whose work contributed much to the researches of the Zoology Department of Leiden University.

**DESCRIPTION** (Figs 22–27). Based on 23 specimens (including the holotype) 74.0–100.5 mm standard length.



**Fig. 22** *Haplochromis teegelaari*. Holotype. Drawn by C. Elzenga.

Depth of body 39.0–43.0 ( $M = 41.0$ ) % of standard length, length of head 32.0–36.0 ( $M = 34.0$ ) %.

Dorsal head profile curved to above the eye then straight and sloping steeply downwards at an angle of 40–60° (mode 45°). Cephalic lateral line pores not enlarged, the tubules of the pre-orbital bone barely visible superficially. Preorbital depth 14.0–19.0 ( $M = 17.0$ ) % of head, least interorbital width 25.0–30.0 ( $M = 27.0$ ) %. Snout as broad as long to slightly broader than long (the modal condition), its length 27.0–31.0 ( $M = 29.0$ ) % head length; when viewed from above the outline of the snout is gently and gradually rounded (see Fig. 23). Eye and orbit virtually

circular, the eye with a definite anterior and anteroventral aphakic aperture; diameter of eye 27.0–33.0 (M=30.0) % of head. Depth of cheek 19.0–25.0 (M=22.0) %.

Caudal peduncle 1.1–1.5 (mode 1.4) times longer than deep, its length 15.0–19.0 (M=17.0) % of standard length.

Mouth very slightly oblique, inclined at an angle of 5–10° (mode 10°). Jaws equal anteriorly, the posterior tip of the maxilla reaching a vertical through the anterior orbital margin, or slightly beyond that level. Lower jaw 1.4–1.8 (modal range 1.6–1.7) times longer than broad, its length 33.0–40.0 (M=37.0) % of head.

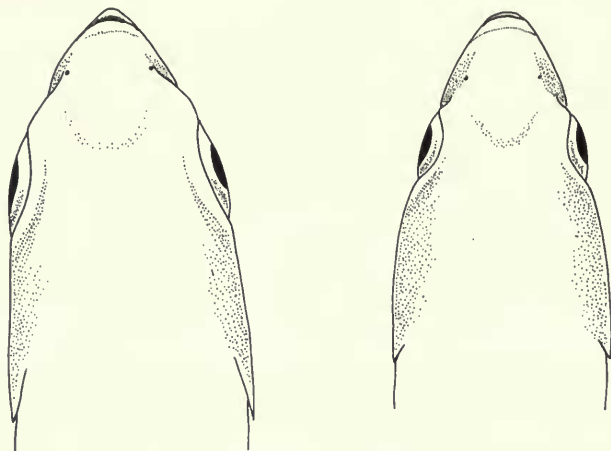
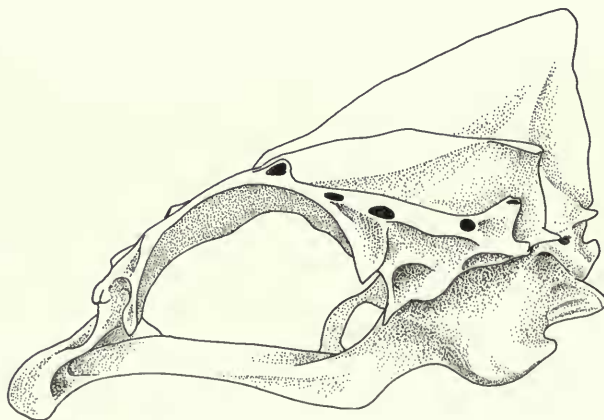


Fig. 23 Dorsal view of the snout in *H. mylergates* (left) and *H. teagelaari* (right), to show differences in outline when viewed from above.

*Gill rakers.* 7 or 8 (rarely 9) on the lower part of the first gill arch, the lower 1 or 2 (occasionally 3) rakers reduced, the remainder moderately stout and blunt.

*Scales.* Ctenoid; lateral line with 31 (f.1), 32 (f.7), 33 (f.12) or 34 (f.3) scales, cheek with 3 or 4 (mode) rows. Six to 7½ (usually 6½ or 7) scales between the dorsal fin origin and the lateral line, 6 or 7 (mode) between the pectoral and pelvic fin bases.

*Fins.* Dorsal with 23 (f.2), 24 (f.12), 25 (f.8) or 26 (f.1) rays, comprising 15 (f.18) or 16 (f.5) spinous and 8 (f.3), 9 (f.14) or 10 (f.6) branched elements. Anal fin with 11 (f.5), 12 (f.16) or 13 (f.2) rays, comprising 3 spines and 8 (f.6), 9 (f.15) or 10 (f.2) branched rays. Pectoral fin 84.0–103.0 (M=91.0) % of head. Pelvic fins with the first branched ray slightly produced. Caudal truncate, scaled on its proximal half (rarely only on its proximal third) or a little further posteriorly.



5mm

Fig. 24 *Haplochromis teagelaari*. Neurocranium in left lateral view.

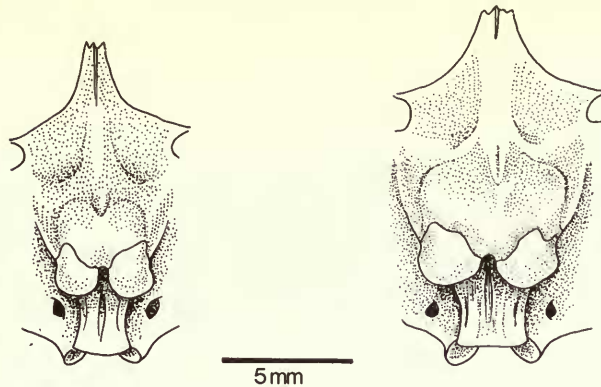


Fig. 25 Apophysis for the upper pharyngeal bones in *H. teegelaari* (left) and *H. mylergates* (right).

**Teeth.** In most specimens the anterior and anterolateral teeth in the *outer row* of the *upper jaw* are moderately stout bicuspid with compressed, recurved, crowns and cylindrical necks; posteriorly and sometimes posterolaterally, the teeth are unicuspid and stout, with recurved crowns. A few specimens have unicuspid teeth throughout the row, or unicuspid anteriorly, bicuspid laterally, and unicuspid posteriorly. There is no obvious correlation between a predominant tooth form and the fish's size.

In the *outer series* of the *lower jaw*, most specimens have only bicuspid teeth, although a few do have either an entirely unicuspid dentition or some unicuspid posteriorly and a mixture of bi- and unicuspid elsewhere in the jaw.

There are 38–54 (modal range 40–44) teeth in the outer row of the upper jaw.

Teeth forming the *inner series* are usually either a mixture of bi- and tricuspid or one of uni- and bicuspid; a few specimens have a mixture of all three types of teeth. There are 1 or 2 (mode) rows of inner teeth in both jaws.

**Osteology.** The neurocranium of *H. teegelaari* (Fig. 24) resembles that of *H. mylergates* (see p. 176 and Fig. 29 below) in having a fairly high-vaulted orbital region and a somewhat curved and relatively steeply sloping preorbital profile; the curvature and slope, however, are less marked than in the skulls of *H. pharyngomylus* and *H. ishmaeli* (see Greenwood, 1974 : 73, figs 43 & 65).

The ventral apophysis for the upper pharyngeal bones is stout, with a large articular area in which there is a substantial contribution from the basioccipitals but none from the prootics, at least in the 2 specimens examined (see Fig. 25).

The *lower pharyngeal bone* (Fig. 26) is stout and enlarged with a broad occlusal surface that is markedly concave over its entire area, a feature best seen when the bone is viewed laterally.

The *lower pharyngeal teeth*, except for those in the marginal row and a small cluster in the posterolateral angles of the bone, are enlarged and molariform; the non-molariform teeth are stout and weakly bicuspid.

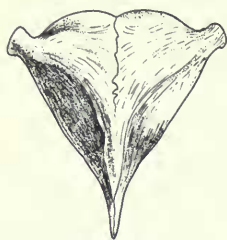
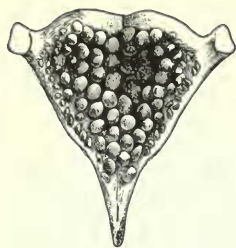
The level of hypertrophy in the pharyngeal mill of *H. teegelaari* (as measured by the extent and degree of pharyngeal tooth molarization and bone enlargement) is comparable with that seen in *H. ptistes*, *H. ishmaeli* and *H. pharyngomylus*, although some specimens of the latter species do exhibit a slightly greater development of the mill.

The dentary in *H. teegelaari*, when compared with that in *H. pharyngomylus* and *H. ishmaeli*, is relatively shallower and more elongate, in these respects resembling the dentary in *H. obtusidens*, *H. ptistes* and *H. mylergates* (see p. 177 below).

There are 29 (f.11) or 30 (f.10) vertebrae (excluding the fused  $PU_1$  and  $U_1$  centra), comprising 13 (f.20) or 14 (f.1) abdominal and 16 (f.11) or 17 (f.10) caudal elements.

**Coloration.** The *live colours* of an *adult sexually active male*, see Fig. 27 (BM(NH) reg. no. 1977.1.28:41), are as follows: Body with a purplish grey dorsum, the purple colour more intense anteriorly. Flanks, chest and belly bright red, caudal peduncle yellow with a faint red overlay; traces of 6 vertical bars are visible on the flanks. Dorsum of head grey with a red flush, remainder





5 mm

Fig. 26 *Haplochromis teogelaari*. Lower pharyngeal bone in occlusal view (above) and ventral view (below).

of head bright red except for the lower lip and branchiostegal membrane which are white. There is a faint lachrymal bar and a dark bar on the vertical preopercular limb.

Dorsal fin light grey with a faint red flush, dark grey lappets, and red maculae on the soft part of the fin. Anal light red anteriorly, greyish posteriorly; egg dummys (anal ocelli) orange to reddish. Caudal hyaline, yellowish proximally, and with red maculae and streaks. Pelvic fins mostly black, the pectorals hyaline. A second specimen (BM(NH) reg. no. 1977.1.28:40) also a sexually active male, differs slightly in having only 3 vertical bars on the flanks, a faint dark band from the opercular spot to the eye, a brownish-purple dorsum to the head, white ventral aspects of the flanks and a red flush on the otherwise black pelvic fins.

*Preserved material.* The coloration of *adult males* only is known. The ground colour is a light sandy brown, shading to yellowish-white on the chest and belly, the chest sometimes with a sooty overlay. Five or 6 distinct dark bars extend across the flanks from the dorsal profile almost to

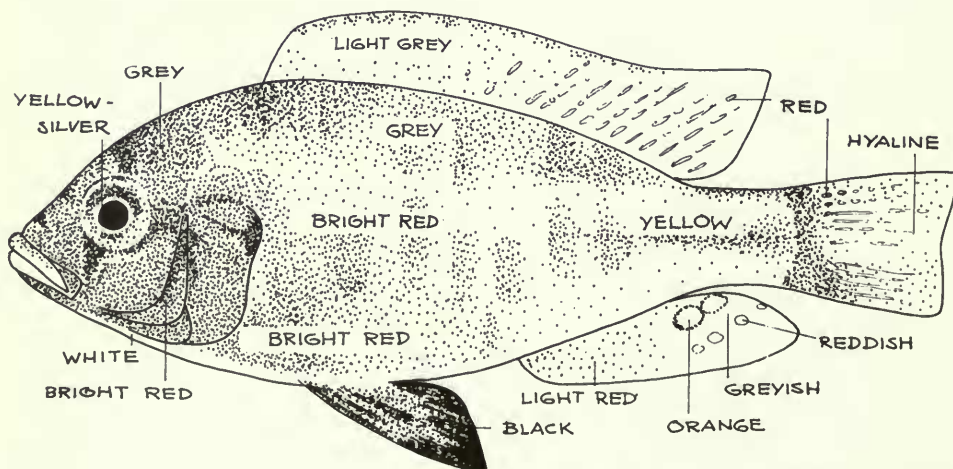


Fig. 27 *Haplochromis teogelaari*. Adult male (sexually active), to show coloration. Drawn by M. J. P. van Oijen.

the ventral outline of the body; immediately above the anal fin two or three bars generally are interconnected midlaterally by a rather ill-defined black blotch. Usually there are two vertical bars on the caudal peduncle, each somewhat broader but less well-defined than those on the flanks. Some specimens have faint indications of a dark midlateral band, especially on the anterior third of the body and again on the caudal peduncle. A faint and frequently interrupted longitudinal band is sometimes visible slightly dorsal to, but following the course of, the upper lateral line.

On the head there are two parallel and well-defined bars crossing the snout; a distinct, and relatively broad, lachrymal stripe extends in some specimens to the level of the maxillary tip, and in others further ventrally onto the lower jaw. Above the eye (and continuing the same line as the lachrymal bar) is a dark stripe which soon expands into a triangular blotch; the blotches of each side meet in the midline (cf. *H. ptistes*, p. 167). In some specimens there is a faint but dark vertical bar on the upper two-thirds of the preoperculum. The operculum itself is silvery.

The dorsal fin is yellowish with black lappets; the caudal fin is also yellowish but with a faint and ill-defined darker centre. The anal varies from hyaline to faint yellow, the pelvics are black, most intensely so over the anterior half of the fin.

**ECOLOGY. Habitat.** The specimens came from three different localities in the Mwanza Gulf (see p. 174). In all three localities, the substrate is mud; at two the depth was *c.* 2 m, and at the third *c.* 8 m.

**FOOD.** The guts of fishes from all three localities were examined, and gave the following results.

(i) Southern part of Mwanza Gulf near Busissi (*c.* 2 m; mud). Five specimens, all containing fragments of small, unidentifiable bivalve shells, but in 4 fishes a number of fragmented gastropod shells (*Melanoides tuberculata*) as well.

(ii) Coastal waters opposite Mashoro Bay, Mwanza Gulf (*c.* 8 m, mud). One specimen containing a few fragments of bivalve shells (specifically indeterminable).

(iii) Northeast of Buzumu Island, near the southern end of the Mwanza Gulf (*c.* 2 m; mud). Nine specimens, all except one containing a mixture of fragmentary, small and unidentifiable bivalve shells together with fragmentary gastropod shells (*Melanoides* and probably one other species); *Melanoides* remains predominate in most guts. The exceptional fish contained only *Melanoides* shell fragments.

**BREEDING.** Nothing is known about the breeding habits of *H. teegelaari*. Only males are available for study; all are adult and most show signs of sexual activity.

**DIAGNOSIS AND AFFINITIES.** The morphological characters distinguishing *H. teegelaari* from *H. ptistes* (see p. 168) are relatively slight and concerned principally with the skull and pharyngeal bones; the two species overlap in all morphometric features.

The degree of enlargement shown by the lower pharyngeal bone in both species is about equal, as is the extent to which the lower pharyngeal dentition is molarized. However, the occlusal surface of the bone is more concave in *H. teegelaari*, and the outline of the bone as seen in occlusal view lacks the small but distinct 'shoulders' immediately posterior to the blade (cf. Figs 26 & 21).

The neurocranium of *H. teegelaari* has a somewhat more vaulted orbit and thus a more steeply sloping and curved dorsal profile to the preorbital region than is the case in *H. ptistes* (cf. Figs 24 & 20).

Another anatomical feature distinguishing the two species is the much longer and more coiled intestine of *H. ptistes* (*c.*  $2\frac{1}{2}$  times the standard length, cf.  $1\frac{1}{2}$ –2 times in *H. teegelaari*).

The most readily diagnostic feature lies in the cephalic markings of preserved specimens. In *H. teegelaari* the supraorbital blotches are clearly triangular, as opposed to rectangular in *H. ptistes*. *Haplochromis ptistes* also has a prominent midlateral stripe, a feature that is barely visible and is frequently interrupted in those specimens of *H. teegelaari* in which it is present. Regrettably, the live colours of *H. ptistes* are still unknown.

From *H. pharyngomylus* and *H. ishmaili* (see Greenwood, 1960: 270–279, figs 19–21), *H. teegelaari* is distinguished by the live coloration of adult males, by its shallower dentary and by its somewhat larger eye (27.0–33.0,  $M=30.0\%$  of head, cf. 23.0–31.8,  $M=26.5\%$  and 23.0–31.0,  $M=27.7\%$  for *H. pharyngomylus* and *H. ishmaili* respectively). From *H. pharyngomylus*, *Haplochromis teegelaari* is further distinguished by its longer pectoral fin (84.0–103.0,  $M=91.0\%$  head,

cf. 68.5–91.0,  $M=80.0\%$ ), and from *H. ishmaeli* by usually having fewer teeth in the outer row of the upper jaw (38–54, modal range 40–44, cf. 38–66, modal range 44–52).

The complete, or almost complete, overlap of *H. teegelaari* with *H. ptistes*, *H. ishmaeli* and *H. pharyngomylus* in all morphometric and meristic characters emphasizes the difficulties encountered in taxonomic work on the Lake Victoria *Haplochromis* species flock. When live specimens are compared, the differences in adult male coloration are striking and diagnostic, and there are also subtle differences in gross morphology which cannot readily be quantified or verbalized. Together, the features of colour and shape enable one to group, quite easily, various individuals into recognizable 'taxa', an action that adds to one's conviction that these assemblages are also biologically valid species.

In most respects *H. teegelaari* seems to be related both to *H. pharyngomylus* and *H. ishmaeli*, and to *H. obtusidens* and *H. ptistes*; in particular this double relationship would seem to be manifest through the specialization expressed in the degree of pharyngeal mill hypertrophy. Similarities in neurocranial shape shared by *H. teegelaari*, *H. ishmaeli* and *H. pharyngomylus* (see above, p. 171) are probably of little value for indicating relationships because, apart from the enlarged ventral apophysis (a correlate of pharyngeal bone hypertrophy), the skull form in all three species departs little from the basic Lake Victoria *Haplochromis* type (see Greenwood, 1974). The supposedly more derived neurocranial shape of *H. ptistes* and *H. obtusidens* could, however, serve to link the two species in a phyletic lineage distinct from the lineage (or lineages) containing *H. teegelaari*, *H. ishmaeli* and *H. pharyngomylus*.

Whether or not, phylogenetically speaking, *H. teegelaari* should be associated with *H. ishmaeli* and *H. pharyngomylus* cannot be established on the basis of any derived characters shared by these three taxa alone. Likewise, there are no apomorph features shared only by *H. teegelaari* and *H. ptistes*, their common apomorph characters being shared also with *H. pharyngomylus* and *H. ishmaeli*.

Thus, for the moment, the phyletic relationships of *H. teegelaari* remain obscure, but with the probability that the species does not share an immediate common ancestor with *H. obtusidens* and *H. ptistes*.

#### STUDY MATERIAL AND DISTRIBUTION RECORDS

Museum and Reg. No.	Locality	Collector
	TANZANIA	
BM(NH) 1977.1.10:16 (Holotype)	Southern end of Mwanza Gulf, near Busissi (c. 2 m)	Anker & Barel
BM(NH) 1977.1.10:17 (Paratype)	Coastal waters opposite Mashoro Bay, Mwanza Gulf (c. 8 m)	Anker & Barel
BM(NH) 1977.1.10:18–26 (Paratypes)	Northeast of Buzumu Island, Mwanza Gulf (c. 2 m)	Anker & Barel
BM(NH) 1977.1.10:27–38 (Paratypes)	Southern part of Mwanza Gulf, near Busissi (c. 2 m)	Anker & Barel

#### *Haplochromis mylergates* sp. nov.

**HOLOTYPE.** An adult male 111.0 mm standard length, from the Speke Gulf west of Nafuba Island, at a depth of c. 10–12 m over a mud bottom, BM(NH) reg. no. 1977.1.10:88.

The trivial name (from the Greek, a miller) refers to the extreme hypertrophy of the pharyngeal apparatus and its effects on the molluscan prey of the species.

**DESCRIPTION** (Figs 28–32). Based on 18 specimens (including the holotype), 102.0–137.0 mm standard length.

Depth of body 38.0–45.0 ( $M=42.0\%$ ) of standard length, length of head 33.0–37.0 ( $M=34.9\%$ ).

Dorsal head profile gently decurved or, less commonly, straight, sloping steeply at an angle of 40–45°, its outline sometimes interrupted by the fairly prominent premaxillary pedicels. The cephalic lateral line pores are enlarged, the supraorbital pore and those on the preorbital bone noticeably so; the lateral line tubules on the preorbital bone, however, are not especially prominent.



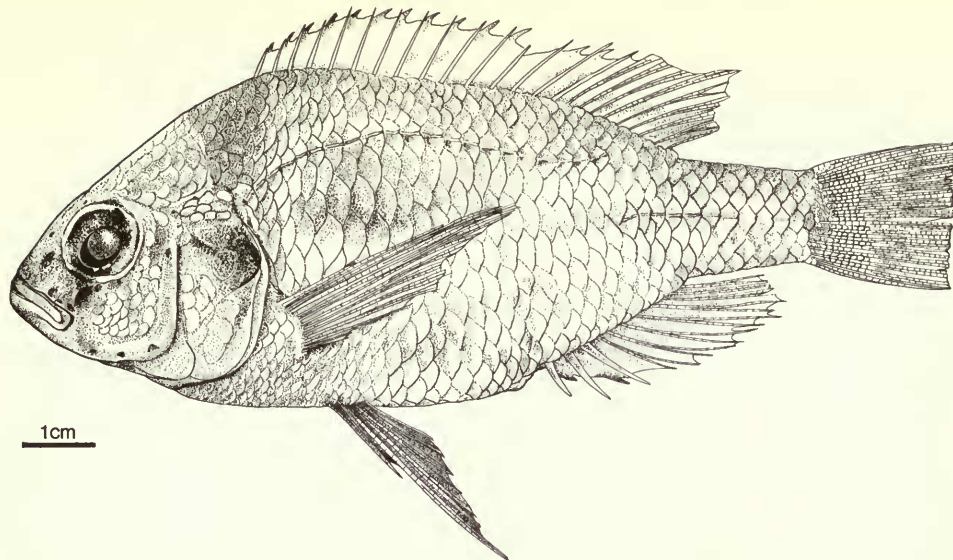


Fig. 28 *Haplochromis mylergates*. Holotype. Drawn by Gordon Howes.

Preorbital depth 12.0–20.0 ( $M=16.0$ )% of head length, interorbital width 26.0–33.0 ( $M=29.0$ )%. Snout as long as broad (modal condition) to 1.2 times longer than broad; when viewed from above, the outline of the snout has a characteristic appearance, narrowing abruptly to form, with the tip of the lower jaw, a relatively acute entry angle (see Fig. 23); length of snout 28.0–33.0 ( $M=31.0$ )% of head. Eye and orbit almost circular, the eye with a definite anterior and anteroventral aphakic aperture; eye diameter 28.0–33.0 ( $M=31.0$ )% of head. Cheek depth 20.0–29.0 ( $M=23.0$ )%.

Caudal peduncle 1.2–1.5 (mode 1.3) times longer than deep, its length 15.0–19.0 ( $M=17.0$ )% of standard length.

Mouth slightly oblique, inclined at an angle of 10–25°. Jaws equal anteriorly, the posterior tip of the maxilla reaching a vertical through the anterior margin of the eye or, less frequently, a little posterior to that level.

Lower jaw 1.3–1.7 (modal range 1.4–1.5) times longer than broad; its length 35.0–43.0 ( $M=39.0$ )% of head.

*Gill rakers.* 8 (rarely 7 or 10) on the lower limb of the first gill arch, the lowermost 2 or 3 (rarely as many as 5) rakers reduced, the remainder relatively short and stout.

*Scales.* Ctenoid; lateral line with 31 (f.2), 32 (f.5), 33 (f.8) or 34 (f.2) scales, cheek with 3 (mode) or 4 rows. Six and a half to  $7\frac{1}{2}$  (rarely 8, mode 7) scales between the dorsal fin origin and the lateral line,  $6\frac{1}{2}$ – $7\frac{1}{2}$  (rarely 8, mode 7) between the pectoral and pelvic fin bases.

*Fins.* Dorsal with 23 (f.2) or 24 (f.16) rays, comprising 14 (f.1), 15 (f.12) or 16 (f.5) spinous and 8 (f.5) or 9 (f.13) branched elements. Anal with 11 (f.4), 12 (f.13) or 13 (f.1) rays, comprising 3 spines (4 in one specimen) and 8 (f.5), 9 (f.12) or 10 (f.1) branched rays. The occurrence of 4 anal spines in a species of *Haplochromis* is extremely rare; it is interesting to note that the specimen with 4 anal spines also has the lowest number (14) of dorsal spines. Pectoral fin 86.0–103.0 ( $M=92.0$ )% of head. Pelvic fins with the first branched ray noticeably produced, proportionately more so in males. Caudal truncate, scaled on its proximal half to two-thirds, rarely scaled over somewhat less than the proximal half of the fin.

*Teeth.* In the outer series of the upper jaw there is usually a mixture of bi- (or weakly bicuspid) and unicuspid teeth, without any positional predominance of one type over the other; in general, however, the posterior one to three teeth are unicuspid and slightly enlarged. A few specimens have only unicuspid teeth in the outer row, but there is no obvious correlation between body size and

the predominance of unicuspid, as is often the case in *Haplochromis* species. The unicuspid teeth are relatively slender but are strong and caniniform, the bicuspid have compressed cylindrical crowns; all the outer teeth are slightly recurved.

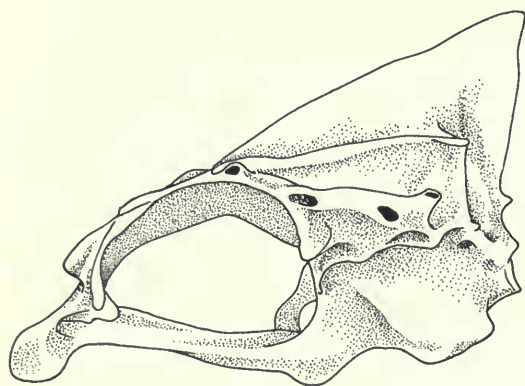
There are 44–60 (modal range 50–55) teeth in the outer series of the upper jaw.

Tooth form and arrangement in the *outer row* of the *lower jaw* are similar to those in the upper jaw, but with a tendency for bicuspid to predominate over unicuspid. Those specimens with an entirely unicuspid upper dentition also have only unicuspid teeth in the lower jaw.

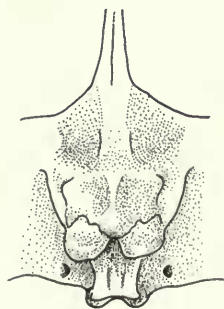
In most specimens the *inner tooth rows* of both jaws have an admixture of bi-, tri- and unicuspid with, usually, tricuspid predominating; rarely are only tricuspid found in these series. There are 1 or 2 (rarely 3) rows of inner teeth in both jaws.

**Osteology.** The *neurocranium* (Fig. 29) of *H. mylergates* closely resembles that of *H. teegelaari*, although the orbital region is somewhat higher and consequently the preorbital dorsal profile slopes more steeply. The ventral pharyngeal apophysis is stout, with a large articulatory surface to which the prootic makes no contribution (at least in the 2 specimens examined).

The *lower pharyngeal bone* (Fig. 30) is very stout, and has a markedly concave occlusal surface, the concavity increasing to almost a broad pit in the centre of the bone. Compared with *H. pharyngomylus* and *H. ishmaeli* (the two other mollusc-crushing species with greatly hypertrophied bones), the lower and upper pharyngeal bones of *H. mylergates* have a much larger surface area (see Fig. 31); as a correlate of this feature, the ventral apophysis on the skull is, relatively speaking, also much enlarged.



10mm



5mm

Fig. 29 *Haplochromis mylergates*. Neurocranium in left lateral view (above), and the apophysis for the upper pharyngeal bones (below).

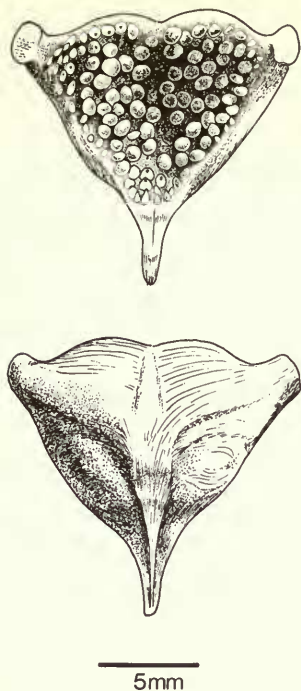


Fig. 30 *Haplochromis mylergates*. Lower pharyngeal bone in occlusal view (above) and ventral view (below).

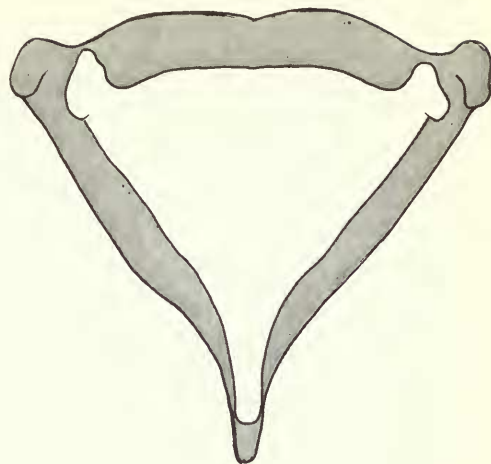


Fig. 31 Outline of the lower pharyngeal bone (in occlusal view) of *H. mylergates* (grey shading), with that of *H. ishmaeli* (in white) superimposed on it. The bones are from a specimen of *H. ishmaeli* 105.0 mm S.L. (28.0 mm neurocranial length), and from a *H. mylergates* 109.0 mm S.L. (29.5 mm neurocranial length).

All the lower pharyngeal teeth (Fig. 30), except for a few in the posterolateral angles of the bone and a few in the outer row, are enlarged and molariform; the non-molariform teeth are stout and weakly cuspidate.

As in *H. teegelaari*, the dentary in *H. mylergates* is relatively shallow and elongate when compared with that bone in *H. pharyngomylus* and *H. ishmaeli*.

There are 29 (f.9) or 30 (f.8) vertebrae (excluding the fused  $PU_1$  and  $U_1$  centra), comprising 13 (f.13) or 14 (f.4) abdominal and 16 (f.13) or 17 (f.4) caudal elements.

**Coloration.** Data on live colours are available from an adult and sexually active male (BM(NH) reg. no. 1977.1.28:43), see Fig. 32. The body has a red dorsum which darkens posteriorly; the flanks and caudal peduncle are yellow to yellowish-green, becoming white ventrally; the chest and belly are a very light red. The head has a bright red dorsal surface and ethmoidal region; the preorbital region is a light reddish-grey while the cheeks and operculum are yellow with a red overlay. A faint lachrymal stripe is present. The lower jaw and branchiostegal membrane are whitish.

The dorsal fin is red anteriorly, hyaline posteriorly but with red maculae and streaks between the rays. The anal is whitish-grey, with orange egg dummies (ocelli), the caudal hyaline with red streaks and maculae. Pelvic fins are greyish posteriorly, black proximally; the pectorals hyaline with a red flush.

**Preserved material. Adult males.** The dorsum and the flanks to about the level of the lower lateral line are greyish-sandy to sandy; below this level the flanks, belly and chest are silvery white.

The dorsal surface of the head, excluding the snout, is sandy, the snout (both dorsally and laterally) is greyish. The cheek is silvery grey, the greater part of the opercular region silvery but the upper quarter of the operculum itself is usually darker. There are no traces of markings on the snout, but a weak and often ill-defined lachrymal stripe or blotch is present; generally this mark does not reach ventrally much below the margin of the preorbital bone but in a few specimens it extends (albeit very faintly) to a level slightly below the gape.



The dorsal, caudal and anal fins are greyish-hyaline, and are immaculate. The pelvics are black over about the anterior half of each fin, and variously sooty over the remainder.

*Adult females.* Only 3 specimens (all apparently spent and quiescent) are available. The body and head coloration is essentially like that of males except that there is no lachrymal bar or blotch. All the fins are hyaline, but there are very faintly sooty lappets to the spinous dorsal, and a light scattering of melanophores on the membrane between the middle few rays of the caudal fin; when the caudal is closed it appears to have a dark midlateral region.

**ECOLOGY.** *Habitat.* The species is known from three localities in the Speke Gulf (see p. 179). In all, the substrate is mud, and the depth between *c.* 8 and 12 m.

**FOOD.** Two of the 16 specimens examined were empty, the remainder all contained fragments of mollusc shells in their stomachs and intestines. The gastropod *Melanoides tuberculata* was present in all specimens, usually as the sole or predominant food organism, but in 3 fishes there were, in addition to the snails, a few fragments of bivalve shells (unfortunately too fragmentary to allow further identification).

**BREEDING.** Nothing is known about the reproductive habits of *H. mylergates*. All the specimens examined are adults, the two largest (128.0 and 137.0 mm S.L.) being females.

**DIAGNOSIS AND AFFINITIES.** From all other Lake Victoria *Haplochromis* species with a hypertrophied pharyngeal mill, *H. mylergates* is distinguished by the coloration of its adult males and by the relatively greater surface area of its pharyngeal bones; further, the lower pharyngeal bone is more concave than in any other species. The shape, in dorsal view, of the snout outline is also diagnostic (see Fig. 23).

From the 3 species with the most hypertrophied pharyngeal mills (*H. ishmaeli*, *H. pharyngomylus* and *H. teegelaari*), *Haplochromis mylergates* is further distinguished as follows:

(i) From *H. pharyngomylus* (see Greenwood, 1960 : 270, fig. 19) by its slightly deeper body (38.0–45.0, *M* = 42.0% standard length, cf. 33.8–42.0, *M* = 38.5%), larger eye, even in specimens of a comparable size or larger (28.0–33.0, *M* = 31.0% head, cf. 23.0–31.8, *M* = 26.5%), enlarged cephalic lateral line pores (especially those of the preorbital bone and the pore situated immediately above the eye), longer pectoral fin (86.0–103.0, *M* = 92.0% head, cf. 68.5–91.0, *M* = 79.6%) and more numerous teeth in the outer row of the upper jaw (44–60, modal range 50–55, cf. 30–42, mode 36).

(ii) From *H. ishmaeli* (see Greenwood, 1960 : 275, fig. 21) by its larger eye, even in specimens of a comparable size or larger (28.0–33.0, *M* = 31.0% head, cf. 23.0–31.0, *M* = 27.7%), by the larger scales on its chest ( $6\frac{1}{2}$ – $7\frac{1}{2}$ , rarely 8, cf. 8 or 9, rarely 7) and by the enlarged cephalic lateral line pores (again, those on the preorbital bone and that immediately above the eye).

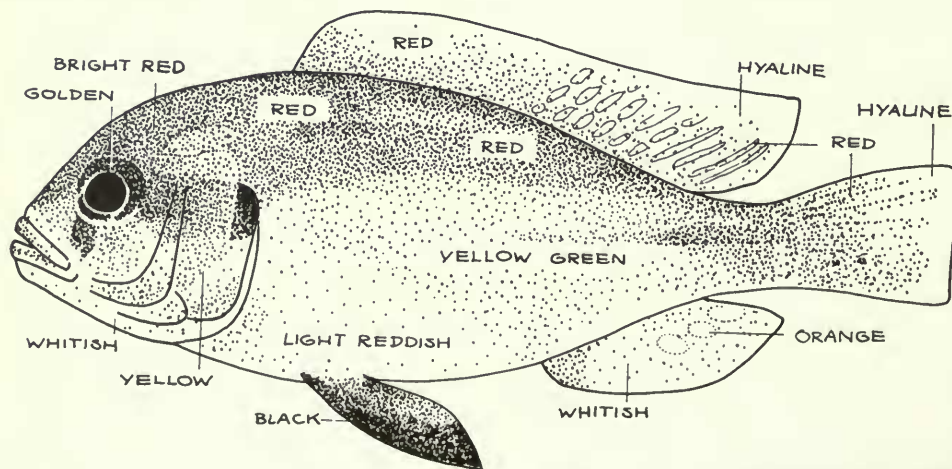


Fig. 32 *Haplochromis mylergates*. Adult male (sexually active), to show coloration. Drawn by M. J. P. van Oijen.

(iii) From *H. teegelaari* (see above, p. 169, Figs 22–27) by the absence of distinct cephalic markings (especially the large supraorbital bars or blotches), the absence of vertical bars on the body of preserved specimens, by the enlarged cephalic lateral line pores and by the presence of rather more teeth in the outer row of the upper jaw (44–60, modal range 50–55, cf. 38–54, modal range 40–44).

As with *H. teegelaari* (see above p. 174) it is difficult to determine the precise phyletic relationships of *H. mylergates*, and for the same reasons: a lack of apomorph characters that are indisputably non-convergent ones. In both species the most obvious apomorph features are connected with the hypertrophy of the pharyngeal mill. Whatever the phyletic relationships of *H. mylergates* may be (that is, either with the *H. obtusidens*–*H. ptistes* lineage or with the *H. ishmaeli*–*H. pharyngomylus* one) it must be considered to have the most highly developed pharyngeal mill of all. In terms of its habitat and depth preferences *H. mylergates* does not, however, seem to differ significantly from such species as *H. ishmaeli* and *H. pharyngomylus*, but more data on distribution and, especially, feeding habits are required before this impression is confirmed.

Since *H. mylergates* does not share the derived neurocranial features of *H. obtusidens* and *H. ptistes* it cannot be placed in that lineage. Its specialized features (pharyngeal bone shape and size, see above) in themselves do not allow its addition to the *H. ishmaeli*–*H. pharyngomylus* lineage with any certainty since these could well be products of convergent evolution. For the moment the species must remain in a phyletic limbo (where it joins a number of other members of the Lake Victoria *Haplochromis* flock).

#### STUDY MATERIAL AND DISTRIBUTION RECORDS

Museum and Reg. No.	Locality	Collector
	TANZANIA	
BM(NH) 1977.1.10:88 (Holotype)	Speke Gulf, west of Nafuba Island (c. 10–12 m)	Anker & Barel
BM(NH) 1977.1.10:89–90 (Paratypes)	Speke Gulf, west of Nafuba Island (c. 10–12 m)	Anker & Barel
BM(NH) 1977.1.10:91 (Paratype)	Speke Gulf, midway between Kisoria Point and Nafuba Island (c. 8 m)	Anker & Barel
BM(NH) 1977.1.10:92–105 (Paratypes)	Speke Gulf; bay north of Nafuba Island (c. 10 m)	Anker & Barel

#### Acknowledgements

Both the authors are much indebted to the many people who assisted with the field work in Tanzania; in particular we wish to thank Dr G. K. Libaba, Director of Fisheries, Tanzania, whose generous help, enthusiasm and hospitality greatly aided the work of Drs Anker and Barel. We must also thank Dr J. Okedi, Director of E.A.F.F.R.O., Jinja, and the members of the U.N.D.P. team who helped the senior author during his work on Lake Victoria in 1970 (the full results of which will be published in the next part of this revision). Dr L. B. Mkwizu (then acting principal of the Freshwater Fisheries Institute, Nyegezi) and Dr H. Bon, are to be thanked for the unstinted help they gave to Drs Anker and Barel.

We also have much pleasure in thanking our colleagues at the British Museum (Natural History) and the Zoology Department of Leiden University for their help at various stages in the preparation of this paper. In particular we thank Mr Gordon Howes (who has provided all the anatomical illustrations, and a great deal of assistance in innumerable other ways), Mr C. Elzenga who drew the figure of *H. teegelaari* and Mr M. J. P. van Oijen who made all the other illustrations of whole fishes used in this paper, except Fig. 28.

The senior author is greatly indebted to Professor Pieter Dullemeijer of Leiden University for the hospitality and facilities he has given him on numerous visits to the Zoology Department there.

Finally, the junior author would express his gratitude to the Netherlands Foundation for the Advancement of Tropical Research (WOTRO) for their generous financial aid which enabled

him and Dr Anker to visit Tanzania and thus collect the data and material on which much of this paper is based.

## Appendix: The live coloration of certain previously described *Haplochromis* species

M. J. P. van Oijen  
Leiden University

No information was available on the live colours of several *Haplochromis* species described, or redescribed, in previous parts of this revision. Live coloration, especially that of adult male fishes, is an important diagnostic character (see Greenwood, 1974), and is often the easiest and most reliable character on which to base preliminary field identifications (especially when the worker is faced with several hundreds of specimens recently caught in a trawl or seine net); it is also an important biological feature in this closely related species flock.

For these reasons it is essential that colour descriptions should be available for all known species. With this objective in view Drs Anker and Barel took data on live colours not only from the new taxa they collected but also from those species whose coloration was previously unknown or was inadequately documented.

Live specimens were chosen from the catch and immediately photographed (using Kodachrome film) in a cuvette especially made for this purpose. The descriptions given below are based principally on the resulting colour transparencies. One set of transparencies, together with the preserved bodies of the fishes photographed, are now deposited in the British Museum (Natural History); the register number for the specimen is quoted (together with the fish's standard length, sexual state and its locality) as part of each description.

Since the colour descriptions previously published by Greenwood were also based on recently captured specimens, it is thought that emotional factors which could influence colours and colour patterns should be similar to those affecting the specimens described here. However, it should be borne in mind that Greenwood's data were derived from specimens held in air, and were taken from direct observations on the fishes and not from photographs. Another difference that should be noted is the fact that Greenwood's descriptions were compounded from several specimens (albeit ones at a similar stage of sexual development), and sometimes from fishes caught at different localities. The descriptions that follow are each based on a single specimen.

An annotated figure (the outline based on a drawing previously published with the species' description) accompanies each account of coloration. The drawing shows the pattern of body and cephalic markings, and the prominent colours for various parts of the body and fins. The pectoral fin is omitted so as not to obscure details of coloration on the anterior region of the body; notes on pectoral fin coloration are given in the description.

In the descriptions, the number of egg dummies (anal ocelli) refers to the individual described, but it must be realized that the number does show marked intraspecific variability.

### *Haplochromis serranus* (Pfeffer), 1896

see Greenwood (1962 : 152)

Adult ♂, S.L. 182.0 mm (BM(NH) 1977.1.28:28). Fig. 33.

LOCALITY. Mwanza Gulf, depth 7 m, mud bottom.

MARKINGS. Lachrymal stripe and faint opercular blotch.

COLORATION. *Head*. Except for the whitish lips, grey-blue. *Eye*. Iris bluish, inner ring yellow. *Body*. Dorsum, chest and belly grey-blue. Flank yellow-green with three small orange spots, one just above the operculum, the others above the anal and pelvic fins. Caudal peduncle greyish dorsally and greenish ventrally. *Fins*. Dorsal, pectoral and pelvic fins grey-blue. Anal dark red, with orange egg dummies. Caudal very dark proximally and somewhat lighter grey distally, with a faint red flush and dark spots between the rays.